PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-312811
(43)Date of publication of application : 09.11.1999

(51)Int.Cl.

H01L 29/786
H01L 21/336
G02F 1/136

(21)Application number : 10-296216
(22)Date of filing : 02.10.1998

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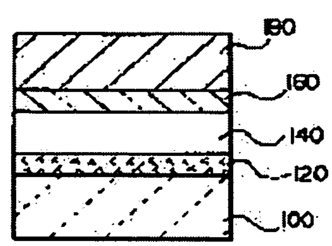
(30)Priority
Priority number : 10 60594 Priority date : 25.02.1998 Priority country : JP

(54) THIN-FILM EXFOLIATION METHOD, THIN-FILM DEVICE TRANSFER METHOD, THIN-FILM DEVICE, ACTIVE MATRIX SUBSTRATE AND LIQUID CRYSTAL DISPLAYING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method, with which a thin-film device formed on a substrate can be exfoliated easily from the substrate.
SOLUTION: An isolation layer 120 is provided on a substrate 100, and a thin-film device 140 such as a TFT, etc., is formed thereon. Exfoliation accelerating ions such as hydrogen ions, for example, are injected into the isolated region 120, in the middle of the formation of the thin film device 140. After the thin- film device 140 has been formed, the thin-film device 140 is connected to a transfer member 180 via a bonded layer 160, and then a laser beam is made to irradiate from the side of the substrate. As a result, the isolation layer 120 is exfoliated, taking advantage of the action of the exfoliation acceleration ions. The thin film device 140 is made to exfoliate from the substrate



100. As a result, the desired thin-film device can be transferred to any type of substrate.

LEGAL STATUS

[Date of request for examination]	09.12.2003
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

CLAIMS

[Claim(s)]
[Claim 1] The 1st process which forms a detached core on a substrate, and the 2nd process which forms a thin film device on said detached core, The 3rd process which produces an exfoliation phenomenon in the inside of the layer of said detached core, and/or an interface, and makes said substrate exfoliate from said detached core, The exfoliation approach of the thin film device which is the exfoliation approach of a thin film device of ****(ing), and is characterized by establishing the ion-implantation process which pours ion into said detached core before said 3rd process.
[Claim 2] The exfoliation approach of the thin film device characterized by including the process which makes said ion poured into said detached core gasificate at said three processes in claim 1.
[Claim 3] It is the exfoliation approach of the thin film device characterized by including the process in which said 3rd process carries out an optical exposure in claim 2 at an account detached core.
[Claim 4] The exfoliation approach of the thin film device characterized by cutting association of the atom or molecule which constitutes said detached core from said ion-implantation process with said ion in claim 1 thru/or either of 3, and giving a damage beforehand to said detached core.
[Claim 5] The exfoliation approach of the thin film device characterized by changing the property of said detached core with said ion, and weakening the adhesion of said detached core and said substrate beforehand at said ion-implantation process in claim 1 thru/or either of 4.
[Claim 6] It is the exfoliation approach of a thin film device that said 2nd process has a thin film transistor formation process for forming a thin film transistor in claim 1 thru/or either of 5, and said thin film transistor formation process is characterized by carrying out said ion-implantation process after said channel layer formation process including a channel layer formation process.
[Claim 7] Said thin film transistor formation process is the exfoliation approach of the thin film device characterized by carrying out said ion-implantation process after said channel pattern formation process in claim 6 including a channel pattern formation process after said channel layer formation process.
[Claim 8] It is the exfoliation approach of the thin film device characterized by for said ion-implantation process forming a mask among said channel layers in claims 6 or 7 on a channel field and the becoming field, and carrying out.
[Claim 9] It is the exfoliation approach of the thin film device characterized by being the process in which said thin film transistor formation process forms gate dielectric film on this channel pattern after said channel pattern formation process in claim 7, and on this gate dielectric film, and carrying out said ion-implantation process by using said gate electrode as a mask including said channel field and the process which forms a gate electrode in the field which counters.
[Claim 10] It is the exfoliation approach of the thin film device characterized by pouring in simultaneously the impurity ion with which said ion-implantation process is driven into either [at least] the source field in said channel pattern, or a drain field in claims 8 or 9, and said ion which mass is lighter than it and is driven into said detached core.
[Claim 11] Said ion-implantation process is the exfoliation approach of the thin film device characterized by carrying out in front of said crystallization process including the process in which said

thin film transistor formation process forms an amorphous silicon layer as said channel layer in claim 6, and the crystallization process which laser annealing is carried out [process] and crystallizes the account amorphous silicon layer of back to front.
[Claim 12] It is the exfoliation approach of the thin film device characterized by said ion being a hydrogen ion in claim 1 thru/or either of 11.
[Claim 13] The exfoliation approach of the thin film device characterized by making into less than 350 degrees C process temperature of the process carried out after said ion-implantation process in claim 12.
[Claim 14] The thin film device which uses the exfoliation approach of ** for claim 1 thru/or either of 13, exfoliates from said substrate, and changes.
[Claim 15] The active-matrix substrate which is a active-matrix substrate with which the pixel section is constituted including the thin film transistor arranged in the shape of a matrix, and the pixel electrode connected to the end of the thin film transistor, and was manufactured by imprinting the thin film transistor of said pixel section using an approach according to claim 6 to 13.
[Claim 16] The liquid crystal display manufactured using the active-matrix substrate according to claim 15.
[Claim 17] The 1st process which forms the 1st detached core on a substrate, and the 2nd process which forms the transferred layer containing a thin film device on said 1st detached core, The 3rd process which forms the 2nd detached core which consists of water solubility or organic solvent melting nature adhesives on said transferred layer, It borders on said 1st detached core at the 4th process which joins a primary imprint object on said 2nd detached core. The 5th process which removes said substrate from said transferred layer, and the 6th process which joins a secondary imprint object to the underside of said transferred layer, The imprint approach of the thin film device characterized by imprinting said transferred layer which said 2nd detached core is contacted to water or an organic solvent, has the 7th process which removes said primary imprint object from said transferred layer bordering on said 2nd detached core, and contains said thin film device on a secondary imprint object.
[Claim 18] The 1st process which forms the 1st detached core on a substrate, and the 2nd process which forms the transferred layer containing a thin film device on said 1st detached core, The 3rd process which forms the 2nd detached core which consists of the adhesives which have an exfoliation operation by heating or UV irradiation on said transferred layer, It borders on said 1st detached core at the 4th process which joins a primary imprint object on said 2nd detached core. The 5th process which removes said substrate from said transferred layer, and the 6th process which joins a secondary imprint object to the underside of said transferred layer, The imprint approach of the thin film device characterized by imprinting said transferred layer which carries out UV irradiation, has heating or the 7th process which removes said primary imprint object from said transferred layer bordering on said 2nd detached core for said 2nd detached core, and contains said thin film device on a secondary imprint object.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the exfoliation approach of a thin film device, the imprint approach of a thin film device, a thin film device, a active-matrix substrate, and a liquid crystal display.
[0002]
[Background of the Invention] For example, it faces manufacturing the liquid crystal display using a thin film transistor (TFT), and passes through the process which forms a thin film transistor by CVD etc. on a substrate. Since the process which forms a thin film transistor on a substrate is accompanied by high temperature processing, a substrate needs to use what has the high thing, i.e., the softening temperature, and the high melting point of the construction material which is excellent in thermal resistance. Therefore, in current, quartz glass is used as a substrate which bears the temperature of about 1000 degrees C, and heat-resisting glass is used as a substrate which bears the temperature around 500 degrees C.
[0003] As mentioned above, the substrate carrying a thin film device must satisfy the conditions for manufacturing those thin film devices. That is, it is determined that the substrate to be used will surely fulfill the manufacture conditions of the device carried.
[0004] However, when its attention is paid only to the phase after the substrate carrying thin film devices, such as TFT, is completed, above-mentioned "substrate" is not sometimes necessarily desirable.

[0005] For example, although a quartz substrate, a heat-resisting glass substrate, etc. are used as mentioned above when passing through the manufacture process accompanied by high temperature processing, these are dramatically expensive, therefore cause lifting of a product price.
[0006] Moreover, a glass substrate is heavy and has a property of a crack or a cone. Although what cannot break easily even if it is cheap as much as possible, it is light and it bears and drops also on deformation of some with the liquid crystal display used for portable electronic devices, such as a palmtop computer and a portable telephone, is desirable, actually, a glass substrate is heavy, and is weak to deformation, and it is common that there is fear of destruction by drop.
[0007] That is, it was very difficult for a slot to be between the desirable properties required of the constraint which comes from manufacture conditions, and a product, and to satisfy the conditions and property of these both sides to it.
[0008] Then, an applicant for this patent has proposed the technique of exfoliating from the 1st substrate and making the 2nd substrate imprinting this thin film device, after forming a thin film device on the 1st substrate in the conventional process (Japanese Patent Application No. No. 225643 [eight to]). For this reason, the detached core is formed between the 1st substrate and the thin film device which is a transferred layer. The thin film device which is a transferred layer is made to exfoliate from the 1st substrate, and this transferred layer is made to imprint to a 2nd substrate side by irradiating light at this detached core.

[0009]
[Problem(s) to be Solved by the Invention] According to the experiment of this invention person, when making a thin film device exfoliate from the 1st substrate, it was discovered that an exfoliation phenomenon may not fully arise in a detached core only by irradiating light at a detached core.
[0010] And it became clear that it was [of this invention person] dependent on the property of a detached core wholeheartedly whether it is easy to produce this exfoliation phenomenon according to research.
[0011] Furthermore, the technical problem that it will differ mutually had the laminating relation of the transferred layer to the 1st substrate used when manufacturing a transferred layer, and the laminating relation of the transferred layer to the 2nd substrate which is the imprint place of the transferred layer.
[0012] Then, this invention is to offer the thin film device, active-matrix substrate, and liquid crystal display which use it for the exfoliation approach list of a thin film device compensate [list] that it will be in the condition that a detached core tends to exfoliate, and it was made to make a thin film device exfoliate easily from a substrate, and are manufactured in front of the process which makes a detached core produce an exfoliation phenomenon in exfoliation.
[0013] Other objects of this invention are to offer the imprint approach of the thin film device which can make in agreement the laminating relation of the transferred layer to the substrate used at the time of manufacture of a transferred layer, and the laminating relation of the transferred layer to the imprint object which is the imprint place of the transferred layer.
[0014]
[Means for Solving the Problem] The 1st process at which invention according to claim 1 forms a detached core on a substrate, and the 2nd process which forms a thin film device on said detached core, An exfoliation phenomenon is produced in the inside of the layer of said detached core, and/or an interface, and it is characterized by establishing the ion-implantation process which pours ion into said detached core before said 3rd process in the exfoliation approach of a thin film device of having the 3rd process which makes said substrate exfoliating from said detached core.
[0015] The detached core which has the property which absorbs light that the dependability in device manufacture is high, on substrates, such as a quartz substrate, is prepared, for example, and thin film devices, such as TFT, are formed on the substrate. It joins to the imprint object of a request of a thin film device through the glue line preferably next. Light is irradiated after that at a detached core, and it produces and cheats out of an exfoliation phenomenon in the detached core. Thereby, a thin film device can be made to exfoliate from a substrate by applying the force to a substrate.
[0016] The exfoliation phenomenon of the detached core in an exfoliation process can become remarkable, and a thin film device can be made to exfoliate from a substrate certainly by pouring ion into a detached core in front of an exfoliation process at this time.
[0017] Here, by pouring ion into a detached core beforehand, the operation defined as either of claims 2-5 is made, and the exfoliation phenomenon of a detached core becomes remarkable.
[0018] According to claim 2, the process by which said ion poured into said detached core is gasificated is included in said three processes. If the ion in a detached core is gasificated, in a detached core, internal pressure will arise and the exfoliation phenomenon will be promoted.
[0019] In this case, light can be irradiated at a detached core and the ion for exfoliation can be made to gasificate by that light, as shown in claim 3. If an optical exposure is carried out at this time [side / of a substrate / rear-face], the quantity of light by which optical incidence is carried out to a thin film device layer can be reduced, and degradation of that property can be prevented.
[0020] According to claim 4, at said ion-implantation process, association of the atom or molecule which constitutes said detached core with said ion is cut, and a damage is beforehand given to said detached core. Therefore, the exfoliation phenomenon in the detached core produced at a subsequent exfoliation process is promoted.
[0021] According to claim 5, at said ion-implantation process, the property of said detached core is changed with said ion, and the adhesion of said detached core and said substrate is weakened beforehand. Therefore, the exfoliation phenomenon in the detached core produced at a subsequent

exfoliation process is promoted.
[0022] Invention of claim 6 has a thin film transistor formation process for said 2nd process to form a thin film transistor in claim 1 thru/or either of 5, and said thin film transistor formation process is characterized by carrying out said ion-implantation process after said channel layer formation process including a channel layer formation process.
[0023] A channel formation process turns into a high-temperature-processing process as compared with other processes. Therefore, it is because there is a possibility that ion may be emitted from a detached core at the time of subsequent high temperature processing when the ion for exfoliation phenomenon acceleration is poured in before that at the detached core.
[0024] In claim 6, said thin film transistor formation process is characterized by carrying out said ion-implantation process after said channel pattern formation process including a channel pattern formation process after said channel layer formation process by invention of claim 7.
[0025] If the channel pattern is formed, even if it pours in the ion for exfoliation phenomenon acceleration from a channel pattern side, the area of the channel pattern itself which can serve as a failure of the impregnation will decrease. Therefore, it becomes that it is easy to make ion reach to a detached core.
[0026] Invention of claim 8 is characterized by for said ion-implantation process forming a mask among said channel layers on a channel field and the becoming field, and carrying it out in claims 6 or 7.
[0027] It is because there is a possibility that transistor characteristics may deteriorate when ion is poured into a channel field. In addition, the process which carries out the mask of the channel field and carries out an ion implantation may be before channel pattern formation or after formation.
[0028] In claim 9, said thin film transistor formation process is characterized by carrying out said ion-implantation process by using said gate electrode as a mask after said channel pattern formation process including the process which forms gate dielectric film on this channel pattern, and the process which forms a gate electrode on this gate dielectric film in claim 7.
[0029] Since a gate electrode is formed in a channel and the location which counters, a gate electrode can be used also [field / channel] as a mask with which ion prevents pouring into a channel field. In addition, according to the acceleration voltage of ion, a mask may be further formed on a gate electrode.
[0030] It is characterized by invention of claim 10 pouring in simultaneously the impurity ion with which said ion-implantation process is driven into either [at least] the source field in said channel pattern, or a drain field, and said ion which mass is lighter than it and is driven into said detached core in claims 8 or 9.
[0031] If it carries out like this, the ion-implantation process to a detached core and the impurity ion-implantation process to the source and/or a drain field can be made to serve a double purpose. In addition, since mass is lighter than impurity ion, ion can reach to the detached core in a location deeper than the source and a drain field.
[0032] Said ion-implantation process is characterized by carrying out in front of said crystallization process including the crystallization process which said thin film transistor formation process carries out laser annealing of the process in which an amorphous silicon layer is formed as said channel layer, and its account amorphous silicon layer of back to front in claim 6, and invention of claim 11 crystallizes.
[0033] Crystallinity is raised by the subsequent laser annealing process even if a damage should arise in a channel layer by operation of an ion-implantation process.
[0034] Invention of claim 12 is characterized by said ion being a hydrogen ion in claim 1 thru/or either of 11.
[0035] If a hydrogen ion is poured into a detached core, it can be made to contribute to the operation shown in each of claims 2-4. Since mass is lighter than the source and the impurity ion (boron, Lynn, etc.) driven into a drain, especially the hydrogen ion also fits implementation of invention of claim 9. In addition, as ion which mainly produces gasification of claim 2, nitrogen ion etc. can be mentioned other than a hydrogen ion. Moreover, as ion which mainly produces the damage of claims 3 and 4, or adhesion lowering, Si ion etc. can be mentioned other than a hydrogen ion.
[0036] Invention of claim 13 is characterized by making into less than 350 degrees C process

temperature of the process carried out after said ion-implantation process in claim 12.
[0037] Since it begins to escape from the hydrogen poured into the detached core by being heated by 350 degrees C or more, as for the process which needs the process temperature of 350 degrees C or more, it is desirable to carry out, before the ion-implantation process to a detached core.
[0038] Invention of claim 14 defines the thin film device which uses the exfoliation approach of ** for claim 1 thru/or either of 13, exfoliates from said substrate, and changes. Since the exfoliation from a detached core is easy for this thin film device, there is little mechanical pressure which acts at the time of exfoliation, it ends, and can lessen the defect depending on the magnitude of that load.
[0039] Invention of claim 15 is a active-matrix substrate with which the pixel section is constituted including the thin film transistor arranged in the shape of a matrix, and the pixel electrode connected to the end of the thin film transistor, and defines the active-matrix substrate manufactured by imprinting the thin film transistor of said pixel section using an approach according to claim 6 to 13.
[0040] This active-matrix substrate as well as invention of claim 13 can lessen a defect.
[0041] Invention of claim 16 defines the liquid crystal display manufactured using the active-matrix substrate according to claim 15.
[0042] Since the active-matrix substrate of claim 15 is used for this liquid crystal display, its defect as the whole liquid crystal display also decreases.
[0043] The imprint approach of the thin film device concerning invention of claim 17 The 1st process which forms the 1st detached core on a substrate, and the 2nd process which forms the transferred layer containing a thin film device on said 1st detached core, The 3rd process which forms the 2nd detached core which consists of water solubility or organic solvent melting nature adhesives on said transferred layer, It borders on said 1st detached core at the 4th process which joins a primary imprint object on said 2nd detached core. The 5th process which removes said substrate from said transferred layer, and the 6th process which joins a secondary imprint object to the underside of said transferred layer, Said 2nd detached core is contacted to water or an organic solvent, and it has the 7th process which removes said primary imprint object from said transferred layer bordering on said 2nd detached core, and is characterized by imprinting said transferred layer containing said thin film device on a secondary imprint object.
[0044] After removing the 1st detached core and joining a secondary imprint object to the underside from the underside of a transferred layer, it is made to secede from a primary imprint object from a transferred layer bordering on the 2nd detached core according to invention of claim 17. If it carries out like this, a secondary imprint object will exist in the location in which the original substrate was located to a transferred layer, and the laminating relation of the transferred layer to the original substrate and the laminating relation of the transferred layer to a secondary imprint object are in agreement. here, since water-soluble adhesives or organic solvent melting nature adhesives is used as the 2nd detached core, the 2nd detached core is contacted to water or an organic solvent making it secede from a primary imprint object -- being sufficient .
[0045] By the imprint approach of the thin film device concerning invention of claim 18, as the 2nd detached core under approach invention of claim 17, it replaces with the above-mentioned adhesives and the adhesives which can exfoliate by heating or ultraviolet rays are used.
[0046] In this case, if the 2nd detached core is contacted in the adhesives which can exfoliate by heating or ultraviolet rays making it secede from a primary imprint object, the laminating relation of the transferred layer to the original substrate and the laminating relation of the transferred layer to a secondary imprint object can be made in agreement like invention of claim 17.
[0047]
[Embodiment of the Invention] Next, the gestalt of operation of this invention is explained with reference to a drawing.
[0048] <Gestalt of the 1st operation> drawing 1 - drawing 6 are drawings for explaining the imprint approach of the thin film device which will be the requisite for this invention.
[0049] As shown in [process 1] drawing 1 , a detached core (optical absorption layer) 120 is formed on a substrate 100.

[0050] Hereafter, a substrate 100 and a detached core 120 are explained.
[0051] ** What has the translucency which light may penetrate is used for the explanation substrate 100 about a substrate 100.
[0052] In this case, as for the permeability of light, it is desirable that it is 10% or more, and it is more desirable that it is 50% or more. When this permeability is too low, attenuation (loss) of light becomes large and needs the big quantity of light by exfoliating a detached core 120.
[0053] Moreover, as for a substrate 100, it is desirable to consist of reliable ingredients, and it is desirable to consist of ingredients which were excellent in thermal resistance especially. Although the reason has what process temperature becomes high depending on the class and formation approach (for example, about 350-1000 degrees C) in case it forms the transferred layer 140 and interlayer 142 who mention later, it is because the width of face of setting out of membrane formation conditions, such as the temperature condition, will spread even in such a case on the occasion of formation of the transferred layer 140 grade to a substrate 100 top if the substrate 100 is excellent in thermal resistance.
[0054] Therefore, a substrate 100 has a desirable consisting-of [the strain point]-ingredients more than Tmax thing, when the maximum temperature in the case of formation of the transferred layer 140 is set to Tmax. A thing 350 degrees C or more has a desirable strain point, and, specifically, the component of a substrate 100 has a more desirable thing 500 degrees C or more. As such a thing, the heat resisting glass of quartz glass, Corning 7059, and NEC glass OA-2 grade is mentioned, for example.
[0055] Moreover, although especially the thickness of a substrate 100 is not limited, it is desirable that it is about 0.1-5.0mm, and it is usually more desirable that it is about 0.5-1.5mm. If the thickness of a substrate 100 is too thin, strong lowering will be caused, and if too thick, when the permeability of a substrate 100 is low, it will become easy to produce attenuation of light. In addition, when the permeability of the light of a substrate 100 is high, the thickness may exceed said upper limit. In addition, as for the thickness of a substrate 100, it is desirable that it is uniform so that light can be irradiated at homogeneity.
[0056] ** The explanation detached core 120 of a detached core 120 is receiving any one or two or more operations of physical operations (light, heat, etc.), chemical operations (chemical reaction with a drug solution etc.), or mechanical works (the hauling force, oscillation, etc.), that bonding strength is decreased or extinguished and this urges separation of a substrate 100 to it through this detached core 120.
[0057] The light which it considers as this detached core 120, for example, is irradiated can be absorbed, and what has a property which produces exfoliation (henceforth "exfoliation in a layer" and "interfacial peeling") in the inside of that layer and/or an interface can be mentioned. What it arises that the bonding strength between the atoms of the matter which constitutes a detached core 120, or between molecules disappears or decreases, i.e., ablation, and results in the exfoliation in a layer and/or interfacial peeling by the exposure of light preferably is good.
[0058] Furthermore, a gas may be emitted by the exposure of light from a detached core 120, and the separation effectiveness may be discovered. That is, a detached core 120 absorbs light, it becomes a gas to the case where the component contained in the detached core 120 serves as a gas, and it is emitted for a moment, the steam is emitted, and it may contribute to separation.
[0059] In this invention, after forming the detached core 120 which has such a property, it is the description to pour in the ion for exfoliation acceleration into a detached core 120, and, thereby, the exfoliation phenomenon in the detached core 120 in a subsequent process is promoted. Therefore, a class will not be asked if the exfoliation phenomenon by the physical operation, chemical operation, or mechanical work mentioned above is promoted as ion for exfoliation acceleration.
[0060] Next, as a presentation of such a detached core 120, what is indicated by following A-E is mentioned, for example.
[0061] A. Amorphous silicon (a-Si)
Hydrogen (H) may contain in this amorphous silicon. In this case, as for the content of H, it is desirable that it is extent more than 2 atom %, and it is more desirable that it is 2 - 20 atom % extent. Thus, if specified quantity content of the hydrogen (H) is carried out, by making light an exposure behind,

hydrogen will be emitted, internal pressure will occur in a detached core 120, and it will become the force in which it exfoliates an up-and-down thin film. The content of the hydrogen in an amorphous silicon (H) can be adjusted by setting up suitably conditions, such as membrane formation conditions, for example, the gas presentation in CVD, gas pressure, a gas ambient atmosphere, a quantity of gas flow, temperature, substrate temperature, and charge power.
[0062] With the gestalt of this operation, the ion implantation of the hydrogen ion can be carried out as ion for exfoliation acceleration at one after formation of an amorphous silicon layer of stages as hydrogen is made to contain in a detached core 120 according to this process condition and also being mentioned later. Thereby, the hydrogen more than a constant rate can be made to contain in an amorphous silicon layer, without being influenced by the process conditions of an amorphous silicon.
[0063] B. As various oxide ceramics, such as silicon oxide or a silicic-acid compound, titanium oxide or a titanic-acid compound, a zirconium dioxide or a zirconic acid compound, a lanthanum trioxide, or a lanthanum oxidation compound, ****** (ferroelectric), or semi-conductor silicon oxide, SiO, SiO2, and Si 3O2 are mentioned, and K2SiO3, Li2SiO3, CaSiO3 and ZrSiO4, and Na2SiO3 are mentioned as a silicic-acid compound, for example.
[0064] TiO, Ti2O3, and Ti02 mention as titanium oxide -- having -- as a titanic-acid compound -- BaTi04, BaTiO3, Ba2Ti 9O20, BaTi 5O11, and CaTiO3, SrTiO3, PbTiO3, MgTiO3, ZrTiO2, SnTiO4 and aluminum2 -- TiO5 and FeTiO3 are mentioned.
[0065] As a zirconium dioxide, ZrO2 is mentioned and BaZrO3, ZrSiO4, PbZrO3, MgZrO3, and K2ZrO3 are mentioned as a zirconic acid compound, for example.
[0066] C. The ceramics or dielectrics (ferroelectric), such as PZT, PLZT, PLLZT, and PBZT
D. As nitride-ceramics E. organic polymeric-materials organic polymeric materials, such as silicon nitride, nitriding aluminum, and titanium nitride - CH-, -CO- (ketone), -CONH- (amide), -NH- (imide), - As long as it is what has association (these association is cut by the exposure of light) of COO- (ester), - N=N- (azo), -CH=N- (CIF), etc., and the thing which has many these association especially, what kind of thing may be used. Moreover, organic polymeric materials may have aromatic hydrocarbon (1, two or more benzene rings, or condensed ring of those) in a constructive mood.
[0067] As an example of such organic polymeric materials, polyethylene, polyolefine like polypropylene, polyimide, a polyamide, polyester, polymethylmethacrylate (PMMA), polyphenylene sulfide (PPS), polyether sulphone (PES), an epoxy resin, etc. are raised.
[0068] F. As a metal metal, the alloy containing at least one of aluminum, Li, Ti, Mn, In, Sn, Y, La, Ce, Nd, Pr, Gd, Sm, or sorts of these is mentioned, for example.
[0069] Moreover, although the thickness of a detached core 120 changes with terms and conditions, such as a presentation of the exfoliation object or a detached core 120, lamination, and the formation approach, it is desirable that it is 1nm - about 20 micrometers, it is more desirable that it is 5nm - about micrometers, and it is usually still more desirable [thickness] that it is 5nm - about 1 micrometer. While enlarging power (quantity of light) of light in order to secure the good detachability of a detached core 120 if the homogeneity of membrane formation is spoiled, nonuniformity may arise in exfoliation, when the thickness of a detached core 120 is too small, and thickness is too thick, in case a detached core 120 is removed behind, the activity takes time amount. In addition, as for the thickness of a detached core 120, it is desirable that it is uniform as much as possible.
[0070] Especially the formation approach of a detached core 120 is not limited, but is suitably chosen according to terms and conditions, such as a film presentation and thickness. For example, it CVD(s) (MOCVD and low voltage -- CVD and ECR-CVD are included). Vacuum evaporationo, molecular beam deposition (MB), sputtering, ion plating, The various gaseous-phase forming-membranes methods, such as PVD, electroplating, immersion plating (dipping), various plating, such as electroless deposition, and the Langmuir pro jet (LB) -- law -- The applying methods, such as a spin coat, a spray coat, and a roll coat, various print processes, a replica method, the ink jet method, a powder jet process, etc. are mentioned, and it can also form or more [of these] combining two.
[0071] For example, when the presentation of a detached core 120 is an amorphous silicon (a-Si), it is desirable to form membranes by CVD especially low voltage CVD, or plasma CVD.

[0072] Moreover, when a detached core 120 is constituted from ceramics by the sol-gel method, or when it constitutes from organic polymeric materials, it is desirable the applying method and to form membranes with a spin coat especially.
[0073] As shown in [a process 2], next drawing 2 , the transferred layer (thin film device layer) 140 is formed on a detached core 120. Although the detail after this process 2 is later explained with reference to drawing 8 - drawing 18 , it is carrying out the ion-implantation process for exfoliation acceleration to a detached core 120 with the gestalt of this operation in the middle of the process of drawing 8 - drawing 13 .
[0074] The expanded sectional view of K part (part shown by surrounding with 1 dotted-line chain line in drawing 2) of this thin film device layer 140 is shown in the right-hand side of drawing 2 . It is constituted including TFT (thin film transistor) formed on SiO2 film (middle class) 142, and the thin film device layer 140 possesses the source and the drain layer 146 which this TFT introduced n mold impurity into the polish recon layer, and were formed, the channel layer 144, gate dielectric film 148, the gate electrode 150, an interlayer insulation film 154, and the electrode 152 that consists of aluminum so that it may be illustrated.
[0075] Although Si02 film is used with the gestalt of this operation as an interlayer prepared in contact with a detached core 120, the insulator layer of others, such as Si3N4, can also be used. Although the thickness of Si02 film (interlayer) is suitably determined according to the formation object or extent of a function which can be demonstrated, it is desirable that it is 10nm - about 5 micrometers, and it is usually more desirable that it is 40nm - about 1 micrometer. What demonstrates at least one of the functions as the protective layer which an interlayer is formed for the various object, for example, protects the transferred layer 140 physically or chemically, an insulating layer, a conductive layer, the protection-from-light layer of laser light, the barrier layer for migration prevention, and a reflecting layer is mentioned.
[0076] In addition, the middle class, such as Si02 film, may not be formed depending on the case, but the direct transferred layer (thin film device layer) 140 may be formed on a detached core 120.
[0077] The transferred layer 140 (thin film device layer) is a layer containing thin film devices, such as TFT as shown in the right-hand side of drawing 2 .
[0078] As a thin film device, besides TFT, for example, a thin-film diode, The optoelectric transducer (the photosensor, solar battery) and silicon resistance element which consist of PIN junction of silicon, Other thin film semiconductor devices, an electrode (example: a transparent electrode like ITO and the mesa film), Actuators, such as a switching element, memory, and a piezoelectric device, a micro mirror (piezo thin film ceramics), There are a micro MAG device which combined a magnetic-recording thin film head, a coil, an inductor, the charge of a thin film high magnetic-permiable material, and them, a filter, reflective film, a dichroic mirror, etc.
[0079] Such a thin film device is formed through usually comparatively high process temperature by relation with the formation approach. Therefore, as mentioned above in this case, as a substrate 100, the thing which has high dependability and which can bear that process temperature is needed.
[0080] As shown in [a process 3], next drawing 3 , the thin film device layer 140 is joined to the imprint object 180 through a glue line 160 (adhesion).
[0081] As a suitable example of the adhesives which constitute a glue line 160, various hardening mold adhesives, such as photo-curing mold adhesives, such as reaction hardening mold adhesives, heat-curing mold adhesives, and ultraviolet curing mold adhesives, and aversion hardening mold adhesives, are mentioned. As a presentation of adhesives, what kind of thing is sufficient as an epoxy system, an acrylate system, a silicone system, etc., for example. Formation of such a glue line 160 is made for example, by the applying method.
[0082] After applying hardening mold adhesives on the transferred layer (thin film device layer) 140 and joining the imprint object 180 on it when using said hardening mold adhesives for example, said hardening mold adhesives are stiffened by the hardening approach according to the property of hardening mold adhesives, and the transferred layer (thin film device layer) 140 and the imprint object 180 are pasted up, and it fixes. [0083] when adhesives are photo-curing molds, light is irradiated from

the substrate of light transmission nature, and both the outsides of an imprint object or -- from one outside of the substrate 100 of light transmission nature, or the imprint object 180 of light transmission nature. As adhesives, photo-curing mold adhesives, such as an ultraviolet curing mold which cannot affect a thin film device layer easily, are desirable.
[0084] Water-soluble adhesives can also be used as a glue line 160. As this kind of water-soluble adhesives, it is KEMISHIRU made from for example, KEMITEKKU, Inc. Three Bond 3046 (trade name) by U-451D (trade name) and Three Bond Co., Ltd. etc. can be mentioned.
[0085] The adhesives which have melting nature to various kinds of organic solvents as a glue line 160 can also be used.
[0086] As a glue line 160, the adhesives which present an exfoliation operation with heating can also be used. As this kind of adhesives, RIBAARUFA made from for example, Japanese east DENKO (trade name) can be used.
[0087] As a glue line 160, the adhesives which present an exfoliation operation by UV irradiation can also be used. As this kind of adhesives, the dicing tape D-210 for glass ceramics by LINTEC Corp. and D-636 can be used.
[0088] In addition, unlike a graphic display, a glue line 160 may be formed in the imprint object 180 side, and the transferred layer (thin film device layer) 140 may be pasted up on it. In addition, when imprint object 180 the very thing has an adhesion function, for example, formation of a glue line 160 may be omitted.
[0089] although not limited especially as an imprint object 180 -- a substrate (plate) -- especially a transparence substrate is mentioned. In addition, such a substrate may be monotonous or may be a bow plate. Moreover, compared with said substrate 100, properties, such as thermal resistance and corrosion resistance, may be inferior in the imprint object 180. It is because the reason forms the transferred layer (thin film device layer) 140 in a substrate 100 side in this invention, and imprints the transferred layer (thin film device layer) 140 on the imprint object 180 after that, so it does not depend on the temperature conditions in the case of formation of the transferred layer (thin film device layer) 140 etc. for the property required of the imprint object 180, especially thermal resistance.
[0090] Therefore, when the maximum temperature in the case of formation of the transferred layer 140 is set to Tmax, a glass transition point (Tg) or softening temperature can use the following [Tmax] as a component of the imprint object 0. For example, a glass transition point (Tg) or softening temperature can constitute more preferably 800 degrees C or less of 500 degrees C or less of imprint objects 180 from an ingredient 320 degrees C or less still more preferably.
[0091] Moreover, although what has a certain amount of rigidity (reinforcement) as a mechanical property of the imprint object 180 is desirable, you may have flexibility and elasticity.
[0092] As a component of such an imprint object 180, various synthetic resin or various glass material are mentioned, and various synthetic resin and the usual cheap (low melting point) glass material are desirable especially.
[0093] As synthetic resin, any of thermoplastics and thermosetting resin are sufficient. For example, polyethylene, a polo propylene, an ethylene-pre pyrene copolymer, Polyolefines, such as an ethylene-vinylacetate copolymer (EVA), annular polyolefine, Denaturation polyolefine, a polyvinyl chloride, a polyvinylidene chloride, polystyrene, A polyamide, polyimide, polyamidoimide, a polycarbonate, Polly (4-methyl BENTEN -1), An ionomer, acrylic resin, polymethylmethacrylate, an acrylic-styrene copolymer (AS resin), Butadiene Styrene, a polio copolymer (EVOH), polyethylene terephthalate (PET), Polyester, such as polyp CHIREN terephthalate (PBT) and PURISHI clo hexane terephthalate (PCT), A polyether, a polyether ketone (PEK), a polyether ether ketone (PEEK), Polyether imide, polyacetal (POM), polyphenylene oxide, Denaturation polyphenylene oxide, polyarylate, aromatic polyester (liquid crystal polymer), Polytetrafluoroethylene, polyvinylidene fluoride, other fluorine system resin, A styrene system, a polyolefine system, a polyvinyl chloride system, a polyurethane system, Various thermoplastic elastomer, such as a fluororubber system and a chlorinated polyethylene system, EBOKISHI resin, phenol resin, a urea resin, melamine resin, unsaturated polyester, The copolymer which is mainly concerned with these, a blend object, a polymer alloy, etc. are mentioned,

and silicone resin, polyurethane, etc. can be used combining 1 of sorts of these, and two sorts or more (as a layered product for example, more than two-layer).
[0094] As glass material, silicic-acid glass (quartz glass), silicic-acid alkali glass, soda lime glass, potash lime glass, lead (alkali) glass, barium glass, borosilicate glass, etc. are mentioned, for example. Among these, compared with silicic-acid glass, the melting point is low, and shaping and processing are also comparatively easy the melting point, and, moreover, things other than silicic-acid glass have it, and are desirable. [cheap]
[0095] When using what consisted of synthetic resin as an imprint object 180, while being able to fabricate the large-scale imprint object 180 in one, even if it is complicated configurations, such as what has a bow side and irregularity, it can manufacture easily, and the various advantages that ingredient cost and a manufacturing cost are also cheap can be enjoyed. Therefore, the activity of synthetic resin is advantageous when manufacturing a large-sized and cheap device (for example, liquid crystal display).
[0096] In addition, the imprint object 180 may constitute some devices like what constitutes the device which became independent in itself like a liquid crystal cell, a light filter and an electrode layer, a dielectric layer, an insulating layer, and a semiconductor device.
[0097] Furthermore, the imprint objects 180 may be matter, such as a metal, ceramics, a stone, and timber paper, and may be on the front face of the structures, such as a wall, a column, head lining, and a windowpane, further on the field (up [of the front-face top of the field top of a clock, and an air-conditioner, and a printed circuit board] etc.) of the arbitration which constitutes a certain goods.
[0098] As shown in [a process 4], next drawing 4 , light is irradiated from the rear-face side of a substrate 100.
[0099] After this light penetrates a substrate 100, it is irradiated by the detached core 120. Thereby, the exfoliation in a layer and/or interfacial peeling arise in a detached core 120, and bonding strength is decreased or extinguished.
[0100] It is presumed that it is what is depended on phase changes, such as that ablation produces the principle which the exfoliation in a layer and/or interfacial peeling of a detached core 120 produce in the component of a detached core 120 and bleedoff of the gas contained in the detached core 120, melting further produced immediately after an exposure, and evapotranspiration.
[0101] The fixed ingredient (component of a detached core 120) which absorbed exposure light is excited photochemistry-wise or thermally, ablation means association of the atom of the front face and interior or a molecule being cut, and emitting here, and it mainly appears as a phenomenon in which all or a part of component of a detached core 120 produces phase changes, such as melting and evapotranspiration (evaporation). Moreover, by said phase change, it may be in a minute firing condition and bonding strength may decline.
[0102] Conditions, such as a presentation of a detached core 120, and a class of light irradiated as one of the factor of the, wavelength, reinforcement, the attainment depth, are mentioned by in addition to this being influenced by various factors they are [whether a detached core 120 produces the exfoliation in a layer interfacial peeling is produced, or] the both.
[0103] Here, with the gestalt of this operation, after formation of a detached core 120, in order to make detached core 120 the very thing produce an exfoliation phenomenon more certainly at this 4th process, the ion for exfoliation acceleration is poured in.
[0104] This ion for exfoliation acceleration promotes three either of the followings, or the exfoliation phenomenon of the detached core [in / for an operation of two or more combination / nothing and the 4th process] 120 at least.
[0105] The ion for exfoliation acceleration, for example, the hydrogen, (H) or nitrogen (N) with which one of them was poured into the detached core 120 by operation of this 4th process is gasificated, and, thereby, exfoliation of a detached core 120 is promoted.
[0106] In the ion-implantation process for exfoliation acceleration, other one cut association of the atom or molecule which constitutes a detached core 120 with the ion for exfoliation acceleration, for example, hydrogen, (H), nitrogen (N), or silicon (Si), and it has given the damage beforehand to the detached core 120. Therefore, in the detached core 120 to which the damage was given beforehand, exfoliation arises

comparatively easily by operation of the 4th process.
[0107] In the ion-implantation process for exfoliation acceleration, one of further others changes the property of a detached core 120 with the ion for exfoliation acceleration, for example, hydrogen, (H), nitrogen (N), or silicon (Si), and the adhesion of a detached core 120 and a substrate 100 has weakened it beforehand. Also in this case, in the detached core 120 which the adhesion with a substrate was able to weaken, exfoliation arises comparatively easily by operation of the 4th process.
[0108] As a light irradiated at the 4th process, if a detached core 120 is made to start the exfoliation in a layer, and/or interfacial peeling, what kind of thing may be used, for example, an X-ray, ultraviolet rays, the light, infrared radiation (heat ray), a laser beam, a millimeter wave, microwave, an electron ray, a radiation (alpha rays, beta rays, gamma ray), etc. will be mentioned. A laser beam is desirable at the point of being easy to produce exfoliation (ablation) of a detached core 120 also in it.
[0109] As laser equipment made to generate this laser beam, although various gas laser, solid state laser (semiconductor laser), etc. are mentioned, excimer laser, Nd-YAG laser, Ar laser, a CO2 laser, a CO laser, helium-Ne laser, etc. are used suitably, and especially excimer laser is desirable also in it.
[0110] Since it outputs high energy in a short wavelength region, extremely, excimer laser can make a detached core 120 produce ablation for a short time, and it can exfoliate a detached core 120, without making the imprint object 180 and substrate 100 grade which therefore adjoin produce most temperature rises (i.e., without it producing degradation and breakage).
[0111] Moreover, when it makes it faced that a detached core 120 produces ablation and there is a wavelength dependency of light, as for the wavelength of the laser beam irradiated, it is desirable that it is 100nm - about 350nm.
[0112] An example of permeability to the wavelength of light of a substrate 100 is shown in drawing 7 . It has the property that permeability increases steeply to the wavelength of 200nm so that it may be illustrated. In such a case, light (wavelength of 308nm) with a wavelength of 210nm or more, for example, Xe-Cl excimer laser light, KrF laser light (wavelength of 248nm), etc. are irradiated.
[0113] Moreover, when making a detached core 120 cause phase changes, such as a gas evolution, evaporation, and sublimation, and giving a separation property to it, as for the wavelength of the laser beam irradiated, it is desirable that it is about 350 to 1200nm.
[0114] Moreover, as for especially the energy density in the case of excimer laser, it is desirable the energy density of the laser beam irradiated and to consider as about two 10 - 5000 mJ/cm, and it is more desirable to consider as about two 100 - 500 mJ/cm. Moreover, as for irradiation time, it is desirable to be referred to as about 1 - 1000ns, and it is more desirable to be referred to as about 10 - 100ns. When sufficient ablation etc. does not arise, and an energy density is high, when an energy density is low or irradiation time is short, or irradiation time is long, there is a possibility of having an adverse effect on the transferred layer 140 by the exposure light which penetrated the detached core 120.
[0115] In addition, as a cure in case the exposure light which penetrated the detached core 120 reaches even the transferred layer 140 and does an adverse effect, as shown in drawing 30 , there is the approach of forming the metal membranes 124, such as a tantalum (Ta), on a detached core (laser absorption layer) 120, for example. Thereby, it is thoroughly reflected by the interface of a metal membrane 124, and the laser light which penetrated the detached core 120 does not have an adverse effect on the thin film device above it.
[0116] Next, the force is applied to a substrate 100 and this substrate 100 is made to secede from a detached core 120, as shown in drawing 5 . Although not illustrated in drawing 5 , a detached core may adhere on a substrate 100 after this balking.
[0117] Next, as shown in drawing 6 , the extant detached core 120 is removed by the approach which combined approaches, such as washing, etching, ashing, and polish, or these. It means that the transferred layer (thin film device layer) 140 had been imprinted by the imprint object 180 by this.
[0118] In addition, when a part of detached core has adhered also to the substrate 100 from which it seceded, it removes similarly. In addition, when the substrate 100 consists of an expensive ingredient like quartz glass, and a rare ingredient, reuse (recycle) is preferably presented with a substrate 100. That is, this invention can be applied to the substrate 100 to reuse, and usefulness is high.

[0119] The imprint to the imprint object 180 of the transferred layer (thin film device layer) 140 is completed through each above process. Then, conductive layers, such as clearance of SiO2 film which adjoins the transferred layer (thin film device layer) 140, and wiring of a up to [the transferred layer 140], formation of a desired protective coat, etc. can also be performed.
[0120] Thus, transferred layer (thin film device layer) 140 the very thing which is an exfoliated object is not exfoliated directly. Since it exfoliates in the detached core joined to the transferred layer (thin film device layer) 140, Irrespective of the property of an exfoliated object (transferred layer 140), conditions, etc., easily and certainly, it can exfoliate in homogeneity (imprint), there is also no damage to the exfoliated object (transferred layer 140) in accordance with exfoliation actuation, and the high dependability of the transferred layer 140 can be maintained.
[0121] Next, TFT of for example, CMOS structure is formed as a thin film device layer 140 on a substrate 100 and a detached core 120, and the example of the concrete manufacture process in the case of imprinting this on an imprint object is explained using drawing 8 - drawing 18 . In addition, the ion-implantation process for exfoliation acceleration carried out in the middle of this process is also explained.
[0122] (Process 1) as shown in drawing 8 , on the translucency substrate (for example, quartz substrate) 100, laminating formation of a detached core (for example, LPCVD amorphous silicon layer formed of law) 120, an interlayer (for example, SiO2 film) 142, and the amorphous silicon layer (for example, LPCVD -- formed of law) 143 is carried out one by one, then laser light is irradiated from the upper part all over the amorphous silicon layer 143, and annealing is given. Thereby, the amorphous silicon layer 143 is recrystallized and turns into a polish recon layer. In addition, when carrying out laser annealing in this case with a beam scan, it is desirable in the same part that an optical exposure is carried out 2 times or more so that the beam cores of the beam of each time may lap unlike the beam scan to the above-mentioned detached core 120 (it removes in the case of a Gaussian beam). In this case, it is because there are no evils, such as optical leakage, and the amorphous silicon layer 143 can fully be recrystallized by carrying out a multiplex exposure.
[0123] If it is after formation of a detached core 120 and is before the laser annealing process for crystallization as an operation stage of the impregnation process of the ion for exfoliation acceleration, it is desirable at the point that an ion implantation can be carried out without needing a mask.
[0124] Therefore, as the operation stage, it is after formation of the detached core 120 of (A) drawing 8 , is after formation of an interlayer's 142 (B) interlayer 142 before formation, is after formation of the amorphous silicon layer 143 (before [C]) formation of the amorphous silicon layer 143, and becomes either in front of the laser annealing process for the crystallization. This (A) In - (C), the operation stage of (C) is the most desirable. In the reason, the formation process of the amorphous silicon layer 143, i.e., the formation process of a channel layer, serves as process temperature of about 425 degrees C in the actual condition. When the hydrogen ion is already poured into the detached core 120 as in this case, for example, ion for exfoliation acceleration, there is a possibility that hydrogen may escape from and come out of a detached core 120 at the temperature of 350 degrees C or more. Therefore, as for the impregnation process of the ion for exfoliation acceleration, it is desirable to carry out with the operation stage after the channel stratification (C). However, since there is such no limit depending on the class of ion for exfoliation acceleration, an operation stage (A) and (B) can also be carried out. Moreover, it is desirable on transistor characteristics that the damage resulting from impregnation of the ion for exfoliation acceleration has not arisen in the layer after laser annealing of the amorphous silicon layer 143 was carried out and it was polycrystal-ized. In being (C), even if there is no generating of a damage itself in (A) and (B), and a damage arises in amorphous silicon layer 143 the very thing, the effect of the damage will be reduced according to a subsequent crystallization process.
[0125] In addition, this ion-implantation process for exfoliation acceleration can be carried out using well-known ion implantation equipment. That is, if a hydrogen ion is poured in, for example, the gas containing hydrogen is plasma-ized and the hydrogen ion generated by it can be poured into a detached core 120 by accelerating by electric field.
[0126] As an operation stage (D) of an ion-implantation process, you may be after laser annealing. In

this case, transistor characteristics will not be degraded, if the mask of the part used as a channel field is carried out and it carries out an ion implantation. In addition, a mask is removed after an ion-implantation process. As it is alike (process 2), then is shown in drawing 9 , patterning of the polish recon layer obtained by laser annealing is carried out, and Islands 144a and 144b are formed as a channel pattern.
[0127] The ion-implantation process for exfoliation acceleration can be carried out after the 2nd process (channel pattern formation process) as the operation stage (E) besides (A) - (D) mentioned above. In this case, as shown in drawing 31 , it is on island 144a and 144b, and the mask pattern 201 is formed in the channel field in island 144a and 144b, and the part which counters. And the ion for exfoliation acceleration, for example, a hydrogen ion, is turned and poured into a detached core 120 in the condition. Thereby, hydrogen does not contain to a channel field and transistor characteristics do not deteriorate. In addition, if the ion-implantation process for exfoliation acceleration is completed, a mask pattern 201 will be removed.
[0128] (Process 3) As shown in drawing 10 , wrap gate dielectric film 148a and 148b is formed for Islands 144a and 144b with a CVD method.
[0129] The ion-implantation process for exfoliation acceleration can be carried out after the 3rd process (gate dielectric film) as the operation stage (F) besides (A) - (E) mentioned above. In this case, as shown in drawing 32 , it is on gate-dielectric-film 148a and 148b, and it is desirable to form a mask pattern 202 in the channel field in island 144a and 144b and the part which counters.
[0130] (Process 4) As shown in drawing 11 , the gate electrodes 150a and 150b which consist of polish recon or metal are formed.
[0131] (Process 5) As shown in drawing 12 , the mask layer 170 which consists of polyimide etc. is formed, using gate electrode 150b and the mask layer 170 as a mask, it is a self aryne, for example, the ion implantation of boron (B) is performed. Of this, the p+ layers 172a and 172b are formed.
[0132] The ion-implantation process for exfoliation acceleration can be carried out to this boron ion-implantation process and coincidence as that operation stage (G) besides (A) - (F) mentioned above. In this case, the mixed gas of B-2H6(5%)+H2 (95%) is plasma-ized, the boron ion and hydrogen ion which were generated by that cause are accelerated, and it leads to a substrate, without minding a mass spectrograph. If it does so, even if it is the same acceleration voltage, while the boron ion with heavy mass stops at the polycrystalline silicon layer by the side of the upper layer, the hydrogen ion with light mass will be driven in more deeply, and it will reach to a detached core 120.
[0133] In addition, although gate electrode 150b functions as the mask pattern 201 of drawing 31 , or the mask pattern 202 of drawing 32 similarly at this time, according to acceleration voltage, a mask layer can be further prepared on gate electrode 150b.
[0134] (Process 6) As shown in drawing 13 , the mask layer 174 which consists of polyimide etc. is formed, using gate electrode 150a and the mask layer 174 as a mask, it is a self aryne, for example, the ion implantation of Lynn (P) is performed. Of this, the n+ layers 146a and 146b are formed.
[0135] The ion-implantation process for exfoliation acceleration can be carried out to this Lynn ion-implantation process and coincidence as that operation stage (H) besides (A) - (G) mentioned above. Also in this case, the mixed gas of PH3(5%)+H2 (95%) is plasma-ized, the phosphorus ion and hydrogen ion which were generated by that cause are accelerated, and it leads to a substrate, without minding a mass spectrograph. If it does so, even if it is the same acceleration voltage, while the phosphorus ion with heavy mass stops at the polycrystalline silicon layer by the side of the upper layer, the hydrogen ion with light mass will be driven in more deeply, and it will reach to a detached core 120.
[0136] In addition, although gate electrode 150a functions as the mask pattern 201 of drawing 31 , or the mask pattern 202 of drawing 32 similarly in this case, according to acceleration voltage, a mask layer can be further prepared on gate electrode 150a.
[0137] Moreover, although the operation stage (G) of the above-mentioned ion-implantation process for exfoliation acceleration and (H) were simultaneous with the impurity ion-implantation process to the source in a process 5 and a process 6, and a drain field, they may be separately performed before and behind that.

[0138] (Process 7) As shown in drawing 14 , an interlayer insulation film 154 is formed and Electrodes 152a-152d are selectively formed after contact hole formation.
[0139] Thus, TFT of the formed CMOS structure corresponds to the transferred layer (thin film device layer) 140 in drawing 2 - drawing 6 . In addition, a protective coat may be formed on an interlayer insulation film 154.
[0140] (Process 8) As shown in drawing 15 , the epoxy resin layer 160 as a glue line is formed on TFT of a CMOS configuration, next TFT is stuck on the imprint object (for example, soda glass substrate) 180 through the epoxy resin layer 160. Then, heat is applied, an epoxy resin is stiffened and the imprint object 180 and TFT are pasted up (junction).
[0141] In addition, the photopolymer resin which is ultraviolet curing mold adhesives is sufficient as a glue line 160. In this case, ultraviolet rays are irradiated from the imprint object [not heat but] 180 side, and a polymer is stiffened.
[0142] (Process 9) As shown in drawing 16 , Xe-Cl excimer laser light is irradiated from the rear face of the translucency substrate 100, for example. This produces and cheats out of exfoliation in the inside of the layer of a detached core 120, and/or an interface.
[0143] (Process 10) A substrate 100 is torn off as shown in drawing 17 .
[0144] (Process 11) Finally etching removes a detached core 120. It means that TFT of a CMOS configuration had been imprinted by the imprint object 180 by this as shown in drawing 18 .
[0145] <The gestalt of the 2nd operation>, next the gestalt of operation of the 2nd of this invention are explained with reference to drawing 33 - drawing 35 . In addition, the gestalt of this 2nd operation imprints twice the transferred layer 140 which consists of thin film device layers, and, in addition to the process of drawing 1 of the gestalt of the 1st operation - drawing 6 , the process of drawing 33 - drawing 35 is added.
[0146] Here, with the gestalt of this 2nd operation, the detached core 120 shown in drawing 2 - drawing 5 is called the 1st detached core. Moreover, with the gestalt of this 2nd operation, the glue line 160 of drawing 3 - drawing 6 is called the 2nd detached core. Furthermore, with the gestalt of this 2nd operation, the imprint object 180 of drawing 3 - drawing 6 is called a primary imprint object. Therefore, according to the gestalt of this 2nd operation, in the phase which the process of drawing 6 ended, it means that the transferred layer 140 had been imprinted by the primary imprint object 180 through the 2nd detached core 160.
[0147] With the gestalt of the 2nd operation here, the construction material of the 2nd detached core 160 can use the thing of the same construction material not only as thermofusion nature adhesives and water-soluble adhesives but the 1st detached core 120. In order to make easy exfoliation by this 2nd detached core 160 at this time, the ion implantation which was mentioned above and which was explained with the gestalt of the 1st operation can be performed.
[0148] More nearly hereafter, the additional processing of drawing 33 carried out after the process of drawing 6 - drawing 35 explains 1-3.
[0149] As [additional processing is shown in drawing 33 following the process of 1] drawing 6 , the secondary imprint layer 200 is pasted up on the underside (exposed surface) of the thin film device layer 140 through a glue line 190.
[0150] As a suitable example of the adhesives which constitute a glue line 190, various hardening mold adhesives, such as photo-curing mold adhesives, such as reaction hardening mold adhesives, heat-curing mold adhesives, and ultraviolet curing mold adhesives, and aversion hardening mold adhesives, are mentioned. As a presentation of adhesives, what kind of thing is sufficient as an epoxy system, an acrylate system, a silicone system, etc., for example. Formation of such a glue line 190 is made for example, by the applying method.
[0151] After applying hardening mold adhesives to the underside of the transferred layer (thin film device layer) 140 and joining the secondary imprint object 200 further when using said hardening mold adhesives for example, said hardening mold adhesives are stiffened by the hardening approach according to the property of hardening mold adhesives, and the transferred layer (thin film device layer) 140 and the secondary imprint object 200 are pasted up, and it fixes.

[0152] When adhesives are photo-curing molds, light is preferably irradiated from the outside of the secondary imprint object 200 of light transmission nature. As long as it uses as adhesives photo-curing mold adhesives, such as an ultraviolet curing mold which cannot affect a thin film device layer easily, an optical exposure may be carried out from the primary imprint object 180 side of light transmission nature, or primary [of light transmission nature] and the both sides of the secondary imprint object 180,200.
[0153] In addition, unlike a graphic display, a glue line 190 may be formed in the secondary imprint object 200 side, and the transferred layer (thin film device layer) 140 may be pasted up on it. In addition, when secondary imprint object 200 the very thing has an adhesion function, for example, formation of a glue line 190 may be omitted.
[0154] although not limited especially as a secondary imprint object 200 -- a substrate (plate) -- especially a transparence substrate is mentioned. In addition, such a substrate may be monotonous or may be a bow plate.
[0155] Moreover, compared with said substrate 100, properties, such as thermal resistance and corrosion resistance, may be inferior in the secondary imprint object 200. It is because the reason forms the transferred layer (thin film device layer) 140 in a substrate 100 side in this invention, and imprints the transferred layer (thin film device layer) 140 on the secondary imprint object 200 after that, so it does not depend on the temperature conditions in the case of formation of the transferred layer (thin film device layer) 140 etc. for the property required of the secondary imprint object 200, especially thermal resistance. This point is the same also about the primary imprint object 180.
[0156] Therefore, when the maximum temperature in the case of formation of the transferred layer 140 is set to Tmax, a glass transition point (Tg) or softening temperature can use the following [Tmax] as a component of primary and the secondary imprint object 180,200. For example, a glass transition point (Tg) or softening temperature can constitute more preferably primary and 800 degrees C or less of 500 degrees C or less of secondary imprint objects 180,200 from an ingredient 320 degrees C or less still more preferably.
[0157] Moreover, although what has a certain amount of ** (reinforcement) as a mechanical property of primary and the secondary imprint object 180,200 is desirable, you may have flexibility and elasticity.
[0158] As a component of such primary and the secondary imprint object 180,200, various synthetic resin or various glass material are mentioned, and various synthetic resin and the usual cheap (low melting point) glass material are desirable especially.
[0159] As synthetic resin, any of thermoplastics and thermosetting resin are sufficient. For example, polyethylene, a polo propylene, an ethylene-pre pyrene copolymer, Polyolefines, such as an ethylene-vinylacetate copolymer (EVA), annular polyolefine, Denaturation polyolefine, a polyvinyl chloride, a polyvinylidene chloride, polystyrene, A polyamide, polyimide, polyamidoimide, a polycarbonate, Polly (4-methyl BENTEN -1), An ionomer, acrylic resin, polymethylmethacrylate, an acrylic-styrene copolymer (AS resin), Butadiene Styrene, a polio copolymer (EVOH), polyethylene terephthalate (PET), Polyester, such as polyp CHIREN terephthalate (PBT) and PURISHI clo hexane terephthalate (PCT), A polyether, a polyether ketone (PEK), a polyether ether ketone (PEEK), Polyether imide, polyacetal (POM), polyphenylene oxide, Denaturation polyphenylene oxide, polyarylate, aromatic polyester (liquid crystal polymer), Polytetrafluoroethylene, polyvinylidene fluoride, other fluorine system resin, A styrene system, a polyolefine system, a polyvinyl chloride system, a polyurethane system, Various thermoplastic elastomer, such as a fluororubber system and a chlorinated polyethylene system, EBOKISHI resin, phenol resin, a urea resin, melamine resin, unsaturated polyester, The copolymer which is mainly concerned with these, a blend object, a polymer alloy, etc. are mentioned, and silicone resin, polyurethane, etc. can be used combining 1 of sorts of these, and two sorts or more (as a layered product for example, more than two-layer).
[0160] As glass material, silicic-acid glass (quartz glass), silicic-acid alkali glass, soda lime glass, potash lime glass, lead (alkali) glass, barium glass, borosilicate glass, etc. are mentioned, for example. Among these, compared with silicic-acid glass, the melting point is low, and shaping and processing are also comparatively easy the melting point, and, moreover, things other than silicic-acid glass have it, and are

desirable. [cheap]
[0161] When using what consisted of synthetic resin as a secondary imprint object 200, while being able to fabricate the large-scale secondary imprint object 200 in one, even if it is complicated configurations, such as what has a bow side and irregularity, it can manufacture easily, and the various advantages that ingredient cost and a manufacturing cost are also cheap can be enjoyed. Therefore, the activity of synthetic resin is advantageous when manufacturing a large-sized and cheap device (for example, liquid crystal display).
[0162] In addition, the secondary imprint object 200 may constitute some devices like what constitutes the device which became independent in itself like a liquid crystal cell, a light filter and an electrode layer, a dielectric layer, an insulating layer, and a semiconductor device.
[0163] Furthermore, primary and the secondary imprint objects 180,200 may be matter, such as a metal, ceramics, a stone, and timber paper, and may be on the front face of the structures, such as a wall, a column, head lining, and a windowpane, further on the field (up [of the front-face top of the field top of a clock, and an air-conditioner, and a printed circuit board] etc.) of the arbitration which constitutes a certain goods.
[0164] As [additional processing is shown in 2], next drawing 34 , thermofusion of the thermofusion nature glue line 160 which is the 2nd detached core is heated and carried out. Consequently, since the adhesive strength of the thermofusion nature glue line 160 becomes weaker, it can be made to secede from the primary imprint object 180 by the thin film device layer 140. In addition, this primary imprint object 180 can be repeated and reused by removing the thermofusion nature adhesives adhering to the primary imprint object 180.
[0165] What is necessary is just to dip preferably the field which contains the 2nd detached core 160 at least in pure water that what is necessary is just to make water contact, when the water-soluble adhesives mentioned above as the 2nd detached core 160 are used. What is necessary is just to contact the field which contains the 2nd detached core 160 at least to an organic solvent, when the organic solvent melting nature adhesives mentioned above as the 2nd detached core 160 are used. the field which contains the 2nd detached core 160 at least when the adhesives which present an exfoliation operation by heating or UV irradiation mentioned above as the 2nd detached core 160 are used -- other layers -- minding -- heating -- or what is necessary is just to carry out UV irradiation Moreover, when an ablation layer is used like the 1st detached core 120 as the 2nd detached core, the 2nd detached core 160 is made to produce an exfoliation phenomenon by optical exposure. That exfoliation is promoted by the effectiveness of impregnation ion at this time.
[0166] As [additional processing is shown in drawing 35 by removing the 2nd detached core 160 which adhered to the front face of the thin film device layer 140 at the 3] last, the thin film device layer 140 imprinted by the secondary imprint object 200 can be obtained. Here, the laminating relation of the thin film device layer 140 to this secondary imprint object 200 becomes the same as the laminating relation of the thin film device layer 140 to the original substrate 100, as shown in drawing 2 .
[0167] The imprint to the secondary imprint object 200 of the transferred layer (thin film device layer) 140 is completed through each above process. Then, conductive layers, such as clearance of SiO_2 film which adjoins the transferred layer (thin film device layer) 140, and wiring of a up to [the transferred layer 140], formation of a desired protective coat, etc. can also be performed.
[0168] With the gestalt of the 2nd operation, transferred layer (thin film device layer) 140 the very thing which is an exfoliated object is not exfoliated directly. In order to dissociate in the 1st detached core 120 and the 2nd detached core 160 and to imprint on the secondary imprint object 200, Irrespective of the property of a dissociated object (transferred layer 140), conditions, etc., easily and certainly, it can imprint to homogeneity, there is also no damage to the dissociated object (transferred layer 140) in accordance with separation actuation, and the high dependability of the transferred layer 140 can be maintained.
[0169] If the technique explained with the <gestalt of the 3rd operation> above-mentioned 1st and the gestalt of the 2nd operation is used, the microcomputer constituted using the thin film device as shown in drawing 19 (a), for example can be formed on a desired substrate.

[0170] In drawing 19 (a), the solar battery 340 possessing the PIN junction of an amorphous silicon for supplying the supply voltage of CPU300, RAM320 and the I/O circuits 360 where the thin film device was used and the circuit was constituted, and these circuits is carried on the flexible substrate 182 which consists of plastics etc.
[0171] Since the microcomputer of drawing 19 (a) is formed on the flexible substrate, as shown in drawing 19 (b), since it is lightweight, it has strongly the description that it is strong also to drop in bending.
[0172] The gestalt of <gestalt of the 4th operation> book operation explains the example of the manufacture process in the case of creating the liquid crystal display of the active-matrix mold using a active-matrix substrate as shown in drawing 20 and drawing 21 using the imprint technique of an above-mentioned thin film device.
[0173] (Configuration of a liquid crystal display) As shown in drawing 20 , the liquid crystal display of a active-matrix mold possesses the sources 400 of the illumination light, such as a back light, a polarizing plate 420, the active-matrix substrate 440, liquid crystal 460, the opposite substrate 480, and a polarizing plate 500.
[0174] In addition, if it constitutes as a reflective mold liquid crystal panel which replaced with the source 400 of the illumination light, and adopted the reflecting plate when using a flexible substrate like a plastic film for the active-matrix substrate 440 and the opposite substrate 480 of this invention, there is flexibility and a lightweight active matrix liquid crystal panel strong against an impact and can be realized. In addition, when a pixel electrode is formed with a metal, a reflecting plate and a polarizing plate 420 become unnecessary.
[0175] The active-matrix substrate 440 used with the gestalt of this operation arranges TFT in the pixel section 442, and is a driver built-in active-matrix substrate in which the driver circuit (a scanning-line driver and data-line driver) 444 was carried further.
[0176] The sectional view of the important section of this active matrix liquid crystal display is shown in drawing 21 , and the circuitry of the important section of a liquid crystal display is shown in drawing 22 .
[0177] As shown in drawing 22 , the gate is connected to the gate line G1, one side of a source drain is connected to the data line D1, and the pixel section 442 contains TFT (M1) by which another side of a source drain was connected to liquid crystal 460, and liquid crystal 460.
[0178] Moreover, the driver section 444 is constituted including TFT (M2) formed of the same process as TFT (M1) of the pixel section.
[0179] As shown in the left-hand side of drawing 21 , TFT (M1) in the pixel section 442 is constituted including the source drain layers 1100a and 1100b, channel 1100e, gate-dielectric-film 1200a, gate electrode 1300a, an insulator layer 1500, and the source drain electrodes 1400a and 1400b.
[0180] In addition, a reference number 1700 is a pixel electrode and a reference number 1702 shows the field (electrical-potential-difference impression field to liquid crystal) where the pixel electrode 1700 impresses an electrical potential difference to liquid crystal 460. The orientation film is omitted among drawing. The pixel electrode 1700 is constituted by metals (in the case of the liquid crystal panel of a reflective mold), such as ITO (in the case of the liquid crystal panel of a light transmission mold), or aluminum. Moreover, in drawing 21 , in the electrical-potential-difference impression field 1702 to liquid crystal, although the substrate insulator layer 1000 under the pixel electrode 1700 (interlayer) is removed thoroughly, it is not necessarily limited to this, and since the substrate insulator layer (interlayer) 1000 is thin, when not becoming the hindrance of the electrical-potential-difference impression to liquid crystal, you may leave.
[0181] Moreover, as shown in the right-hand side of drawing 21 , TFT (M2) which constitutes the driver section 444 is constituted including the source, the drain layers 1100c and 1100d, channel 1100f, gate-dielectric-film 1200b, gate electrode 1300b, an insulator layer 1500, and the source drain electrodes 1400c and 1400d.
[0182] In addition, in drawing 21 , a reference number 480 is for example, an opposite substrate (for example, soda glass substrate), and a reference number 482 is a common electrode. Moreover, a

reference number 1000 is SiO2 film, a reference number 1600 is an interlayer insulation film (for example, SiO2 film), and a reference number 1800 is a glue line. Moreover, a reference number 1900 is a substrate (imprint object) which consists for example, of a soda glass substrate.
[0183] (Manufacture process of a liquid crystal display) The manufacture process of the liquid crystal display of drawing 21 is hereafter explained with reference to drawing 23 - drawing 27 .
[0184] First, it forms through the same manufacture process as drawing 8 - drawing 18 on the substrate (for example, quartz substrate) 3000 which it is reliable in TFT (M1, M2) like drawing 23 , and penetrates laser light, and a protective coat 1600 is constituted. In addition, in drawing 23 , a reference number 3100 is a detached core (laser absorption layer) into which the ion for exfoliation acceleration is poured. Moreover, in drawing 23 , both TFT(s) (M1, M2) are taken as MOSFET of n mold. However, it is good also as not the thing limited to this but MOSFET of p mold, and CMOS structure.
[0185] Next, as shown in drawing 24 , a protective coat 1600 and the substrate insulator layer 1000 are etched selectively, and openings 4000 and 4200 are formed selectively. These two openings are simultaneously formed using a common etching process. In addition, although the substrate insulator layer (interlayer) 1000 is thoroughly removed in opening 4200 in drawing 24 , it is not necessarily limited to this, and since the substrate insulator layer (interlayer) 1000 is thin, when not becoming the hindrance of the electrical-potential-difference impression to liquid crystal, you may leave.
[0186] Next, as shown in drawing 25 , the pixel electrode 1700 which consists of metals, such as ITO film or aluminum, is formed. In using the ITO film, it becomes the liquid crystal panel of a transparency mold, and in using metals, such as aluminum, it becomes the liquid crystal panel of a reflective mold. Next, as shown in drawing 26 , a substrate 1900 is joined through a glue line 1800 (adhesion).
[0187] Next, excimer laser light is irradiated from the rear face of a substrate 3000, the operation by the ion for exfoliation acceleration is also used, and a detached core 120 is made to produce an exfoliation phenomenon, as shown in drawing 26 . Then, a substrate 3000 is torn off. Since the force like ** is not required for tearing off at this time, a mechanical damage does not arise in TFT.
[0188] Next, a detached core (laser absorption layer) 3100 is removed. Thereby, the active-matrix substrate 440 as shown in drawing 27 is completed. It has exposed and the electric connection with liquid crystal is possible for the base (field of a reference number 1702) of the pixel electrode 1700. Then, the orientation film is formed in the front face of the insulator layer (interlayers, such as SiO2) 1000 of the active-matrix substrate 440, and pixel electrode 1702 front face, and orientation processing is performed. The orientation film is omitted in drawing 27 .
[0189] And the pixel electrode 1709 and the common electrode which counters are further formed in the front face, the opposite substrate 480 and the active MATORIKU substrate 440 of drawing 21 with which orientation processing of the front face was carried out are closed with a sealing agent (sealant), liquid crystal is enclosed among both substrates, and a liquid crystal display as shown in drawing 21 is completed.
[0190] The gestalt of operation of the 5th of this invention is shown in <gestalt of the 5th operation> drawing 28 .
[0191] With the gestalt of this operation, multiple-times activation of the imprint approach of an above-mentioned thin film device is carried out, on a larger substrate (imprint object) than the substrate of an imprinting agency, two or more patterns containing a thin film device are imprinted, and a large-scale active-matrix substrate is formed eventually.
[0192] That is, on the big substrate 7000, the imprint of multiple times is performed and the pixel sections 7100a-7100P are formed. TFT and wiring are formed in the pixel section as surrounded and shown to the drawing 28 upside by the alternate long and short dash line. In drawing 28 , a reference number 7210 is the scanning line, a reference number 7200 is a signal line and a reference number 7230 is [a reference number 7220 is a gate electrode and] a pixel electrode.
[0193] The large-scale active-matrix substrate carrying a reliable thin film device can be created by repeating and using a reliable substrate or carrying out multiple-times activation of the imprint of a thin film pattern using two or more 1st substrates.
[0194] The gestalt of operation of the 6th of <gestalt of the 6th operation> this invention is shown in

drawing 29 .
[0195] The description of the gestalt of this operation is imprinting two or more patterns containing the thin film device (that is, thin film device with which minimum line width's differs) with which multiple-times activation of the imprint approach of an above-mentioned thin film device is carried out, and design rules' (that is, design rule's when carrying out a pattern design's) differ on a bigger substrate than the substrate top of an imprinting agency.
[0196] In drawing 29 , the driver circuit (8000-8032) created in the more detailed manufacture process rather than the pixel section (7100a-7100p) is created around the substrate 6000 by the imprint of multiple times in the active-matrix substrate of driver loading.
[0197] Since the shift register which constitutes a driver circuit carries out actuation of a logic level to the bottom of a low battery, rather than Pixel TFT, pressure-proofing may be low, and as it is therefore set to TFT more detailed than Pixel TFT, high integration can be attained.
[0198] According to the gestalt of this operation, two or more circuits where design rule level differs (that is, manufacture processes differ) are realizable on one substrate. In addition, since high pressure-proofing is the need like Pixel TFT, a sampling means (thin film transistor M2 of drawing 22) to sample a data signal by control of a shift register may be formed with the same process as Pixel TFT / same design rule.
[0199]
[Example] Next, the concrete example of this invention is explained.
[0200] (Example 1) The quartz substrate (1630 degrees C, a strain point: softening temperature : 1070 degrees C, permeability of excimer laser : about 100%) with a 50mm[50mm by] x thickness of 1.1mm was prepared, and the amorphous silicon (a-Si) film was formed in one side of this quartz substrate as a detached core (laser beam absorption layer) with the low voltage CVD method (Si2 H6 gas, 425 degrees C). The thickness of a detached core was 100nm.
[0201] Next, it is SiO2 as an interlayer on a detached core. The film was formed with the ECR-CVD method (SiH4+O2 gas, 100 degrees C). An interlayer's thickness was 200nm.
[0202] Next, the amorphous silicon film of 50nm of thickness was formed as a transferred layer on the interlayer with the low voltage CVD method (Si2 H6 gas, 425 degrees C), a laser beam (wavelength of 308nm) is irradiated, this amorphous silicon film was crystallized, and it considered as the polish recon film. Then, to this polish recon film, predetermined pattern NINGU was given and the field used as the source drain channel of a thin film transistor was formed. then, a TEOS-CVD method (SiH4+O2 gas) -- 1200nm gate dielectric film SiO2 after forming, form a gate electrode (structure where laminating formation of the refractory metals, such as Mo, was carried out at polish recon), on gate dielectric film, and it carries out an ion implantation, using a gate electrode as a mask -- self align ---like (selfer line) -- the source drain field was formed and the thin film transistor was formed. At this time, the hydrogen ion was poured into coincidence at the detached core. Then, the electrode connected to a source drain field and wiring, and wiring which leads to a gate electrode are formed if needed. Although aluminum is used for these electrodes and wiring, it is not limited to this. Moreover, when worrying about melting of aluminum by the laser radiation of an after process, a high-melting metal (what is not fused by the laser radiation of an after process) may be used rather than aluminum.
[0203] Next, ultraviolet curing mold adhesives were applied on said thin film transistor (thickness: 100 micrometers), further, after joining a transparent large-sized glass substrate (soda glass, softening-temperature:740 degree C, a strain point: 511 degrees C) with a 300mm[200mm by] x thickness of 1.1mm to the paint film as an imprint object, ultraviolet rays were irradiated from the glass substrate side, adhesives were stiffened, and adhesion immobilization of these was carried out.
[0204] Next, Xe-Cl excimer laser (wavelength: 308nm) was irradiated from the quartz substrate side, and the detached core was made to produce exfoliation (exfoliation in a layer, and interfacial peeling) by carrying out the beam scan shown after drawing 31 . The irradiated energy density of Xe-Cl excimer laser was 250 mJ/cm2, and irradiation time was 20ns. In addition, the exposure of excimer laser had a spot beam exposure and a line beam exposure, and when it was a spot beam exposure, the spot exposure was carried out to the predetermined unit field (for example, 8mmx8mm), and it irradiated this spot

exposure, carrying out a beam scan so that the exposure field of each time may not lap (it does not lap all around like). Moreover, in the line beam exposure, it irradiated, carrying out the beam scan of the predetermined unit field (for example, 378mmx0.1mm and 378mmx0.3mm (field where, as for these, 90% or more of energy is obtained)) similarly, so that the exposure field of each time may not lap.
[0205] Then, the quartz substrate and the glass substrate (imprint object) were torn off in the detached core, and the thin film transistor and interlayer who were formed on the quartz substrate were imprinted to the glass substrate side.
[0206] Then, etching, washing, or those combination removed the detached core adhering to the front face of the middle class by the side of a glass substrate. Moreover, processing with the same said of a quartz substrate was performed, and the reuse was presented.
[0207] In addition, if the glass substrate used as an imprint object is a bigger substrate than a quartz substrate, the imprint to a glass substrate from a quartz substrate like this example can be repeatedly carried out to a superficially different field, and many thin film transistors can be formed on a glass substrate from the number of the thin film transistors which can be formed in a quartz substrate. Furthermore, on a glass substrate, a laminating can be carried out repeatedly and more thin film transistors can be formed similarly.
[0208] (Example 2) a detached core -- a separation stratification process -- H (hydrogen) -- 20at(s)% -- the thin film transistor was imprinted like the example 1 except having considered as the amorphous silicon film to contain.
[0209] In addition, adjustment of the amount of H in the amorphous silicon film was performed by setting up suitably the conditions at the time of membrane formation by the low voltage CVD method.
[0210] (Example 3) The thin film transistor was imprinted like the example 1 except having used the detached core as the ceramic thin film (presentation-bTiO3, thickness: 200nm) formed with the sol-gel method with the spin coat.
[0211] (Example 4) The thin film transistor was imprinted like the example 1 except having used the detached core as the ceramic thin film (presentation: BaTiO3, thickness:400nm) formed by sputtering.
[0212] (Example 5) The thin film transistor was imprinted like the example 1 except having used the detached core as the ceramic thin film (presentation :P b (Zr Ti)O3 (PZT) and thickness: 50nm) formed by the laser-ablation method.
[0213] (Example 6) The thin film transistor was imprinted like the example 1 except having used the detached core as the polyimide film (thickness: 200nm) formed with the spin coat.
[0214] (Example 7) The thin film transistor was imprinted like the example 1 except having used the detached core as the polyphenylene sulfide film (thickness: 200nm) formed with the spin coat.
[0215] (Example 8) The thin film transistor was imprinted like the example 1 except having used the detached core as aluminum layer (thickness: 300nm) formed by sputtering.
[0216] (Example 9) As an exposure light, the thin film transistor was imprinted like the example 2 except having used Kr-F excimer laser (wavelength: 248nm). In addition, the energy density of the irradiated laser was 250 mJ/cm2, and irradiation time was 20ns.
[0217] (Example 10) As an exposure light, the thin film transistor was imprinted like the example 2 except having used Nd-YAIG laser (wavelength: 1068nm). In addition, the energy density of the irradiated laser was 400 mJ/cm2, and irradiation time was 20ns.
[0218] (Example 11) The thin film transistor was imprinted like the example 1 except having considered as the thin film transistor of the polish recon film (80nm of thickness) by elevated-temperature process 1000 degree C as a transferred layer.
[0219] (Example 12) As an imprint object, the thin film transistor was imprinted like the example 1 except having used the transparence substrate made from a polycarbonate (glass transition point: 130 degrees C).
[0220] (Example 13) As an imprint object, the thin film transistor was imprinted like the example 2 except having used the transparence substrate made of an AS resin (glass transition point: 70-90 degrees C).
[0221] (Example 14) As an imprint object, the thin film transistor was imprinted like the example 3

except having used the transparence substrate made from polymethylmethacrylate (glass transition point: 70-90 degrees C).
[0222] (Example 15) As an imprint object, the thin film transistor was imprinted like the example 5 except having used the transparence substrate made from polyethylene terephthalate (glass transition point: 67 degrees C).
[0223] (Example 16) As an imprint object, the thin film transistor was imprinted like the example 6 except having used the transparence substrate made from high density polyethylene (glass transition point: 77-90 degrees C).
(Example 17) As an imprint object, the thin film transistor was imprinted like the example 9 except having used the transparence substrate made from a polyamide (glass transition point: 145 degrees C).
[0224] (Example 18) As an imprint object, the thin film transistor was imprinted like the example 10 except having used the transparence substrate made of an epoxy resin (glass transition point: 120 degrees C).
[0225] (Example 19) As an imprint object, the thin film transistor was imprinted like the example 11 except having used the transparence substrate made from polymethylmethacrylate (glass transition point: 70-90 degrees C).
[0226] About examples 1-19, when the condition of the imprinted thin film transistor was guessed the ** view under the naked eye and the microscope, respectively, all had neither a defect nor nonuniformity and the imprint was made by homogeneity.
[0227] As stated above, when using the imprint technique of this invention, it was able to become possible to imprint a thin film device (transferred layer) to various imprint objects, especially exfoliation of a substrate required for an imprint was able to be performed reasonable, without acting too much force. or [that a thin film cannot be formed directly by this] -- or it can be formed by imprint also to what consisted of an ingredient unsuitable for forming, an ingredient with easy shaping, a cheap ingredient, etc., the large-sized body which is hard to move.
[0228] That in which properties, such as thermal resistance and corrosion resistance, are inferior compared with various synthetic resin or a substrate ingredient like glass material with the low melting point can be used especially for an imprint object. therefore -- for example, it can face manufacturing the liquid crystal display in which the thin film transistor (especially poly-Si TFT) was formed on the transparence substrate, and a large-sized and cheap liquid crystal display can be easily manufactured now as an imprint object as a substrate using the quartz-glass substrate which is excellent in thermal resistance by using a transparence substrate of the ingredient which it is cheap and processing tends to carry out like glass material with low various synthetic resin and melting point. Such an advantage is the same also about manufacture of not only a liquid crystal display but other devices.
[0229] Moreover, although the above advantages are enjoyed, since a transferred layer like a functional thin film can be formed to a heat-resistant high substrate like a reliable substrate, especially a quartz-glass substrate and patterning can be carried out further, a reliable functional thin film can be formed on an imprint object irrespective of the material property of an imprint object.
[0230] Moreover, although such a reliable substrate is expensive, it is also possible to reuse it and, therefore, a manufacturing cost is also reduced.
[0231]

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the 1st process in the gestalt of implementation of the 1st of the imprint approach of the thin film device of this invention.
[Drawing 2] It is the sectional view showing the 2nd process in the gestalt of implementation of the 1st of the imprint approach of the thin film device of this invention.
[Drawing 3] It is the sectional view showing the 3rd process in the gestalt of implementation of the 1st of the imprint approach of the thin film device of this invention.
[Drawing 4] It is the sectional view showing the 4th process in the gestalt of implementation of the 1st of the imprint approach of the thin film device of this invention.
[Drawing 5] It is the sectional view showing the 5th process in the gestalt of implementation of the 1st of the imprint approach of the thin film device of this invention.
[Drawing 6] It is the sectional view showing the 6th process in the gestalt of implementation of the 1st of the imprint approach of the thin film device of this invention.
[Drawing 7] It is drawing showing change of the permeability to the wavelength of the laser light of the 1st substrate (substrate 100 of drawing 1).
[Drawing 8] It is the sectional view showing the 1st process for forming the thin film device of drawing 2 .
[Drawing 9] It is the sectional view showing the 2nd process for forming the thin film device of drawing 2 .
[Drawing 10] It is the sectional view showing the 3rd process for forming the thin film device of drawing 2 .
[Drawing 11] It is the sectional view showing the 4th process for forming the thin film device of drawing 2 .
[Drawing 12] It is the sectional view showing the 5th process for forming the thin film device of drawing 2 .
[Drawing 13] It is the sectional view showing the 6th process for forming the thin film device of drawing 2 .
[Drawing 14] It is the sectional view showing the 7th process for forming the thin film device of drawing 2 .
[Drawing 15] It is a sectional view to show the process shown in drawing 3 in a detail.
[Drawing 16] It is a sectional view to show the detail of the process shown in drawing 4 .
[Drawing 17] It is a sectional view to show the detail of the process shown in drawing 5 .
[Drawing 18] It is a sectional view to show the detail of the process shown in drawing 6 .
[Drawing 19] (a) and (b) are both the perspective views of the microcomputer manufactured using this invention.
[Drawing 20] It is drawing for explaining the configuration of a liquid crystal display.
[Drawing 21] It is drawing showing the cross-section structure of the important section of a liquid crystal display.

[Drawing 22] It is drawing for explaining the configuration of the important section of a liquid crystal display.
[Drawing 23] It is the sectional view of the device in which the 1st process of the manufacture approach of the active-matrix substrate using this invention is shown.
[Drawing 24] It is the sectional view of the device in which the 2nd process of the manufacture approach of the active-matrix substrate using this invention is shown.
[Drawing 25] It is the sectional view of the device in which the 3rd process of the manufacture approach of the active-matrix substrate using this invention is shown.
[Drawing 26] It is the sectional view of the device in which the 4th process of the manufacture approach of the active-matrix substrate using this invention is shown.
[Drawing 27] It is the sectional view of the device in which the 5th process of the manufacture approach of the active-matrix substrate using this invention is shown.
[Drawing 28] It is drawing of a ****** sake about other examples of the imprint approach of the thin film device of this invention.
[Drawing 29] It is drawing of a ****** sake about the example of further others of the imprint approach of the thin film device of this invention.
[Drawing 30] It is drawing of a ****** sake about the modification of the imprint approach of the thin film device of this invention.
[Drawing 31] It is the sectional view showing the impregnation process of the ion for exfoliation acceleration carried out after the process of drawing 9 .
[Drawing 32] It is the sectional view showing the impregnation process of the ion for exfoliation acceleration carried out after the process of drawing 10 .
[Drawing 33] The additional processing at the time of the 2 times imprint performed by continuing at the process of drawing 6 is the outline sectional view showing 1.
[Drawing 34] The additional processing at the time of the 2 times imprint performed by continuing at the process of drawing 33 is the outline sectional view showing 2.
[Drawing 35] The additional processing at the time of the 2 times imprint performed by continuing at the process of drawing 34 is the outline sectional view showing 3.
[Description of Notations]
100 Substrate
120 Detached Core
140 Thin Film Device Layer
160 Glue Line
180 Imprint Object

[Translation done.]

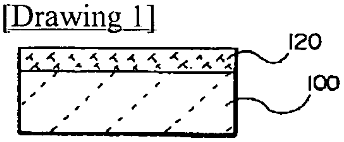
* NOTICES *

`Japan Patent Office is not responsible for any damages caused by the use of this translation.`

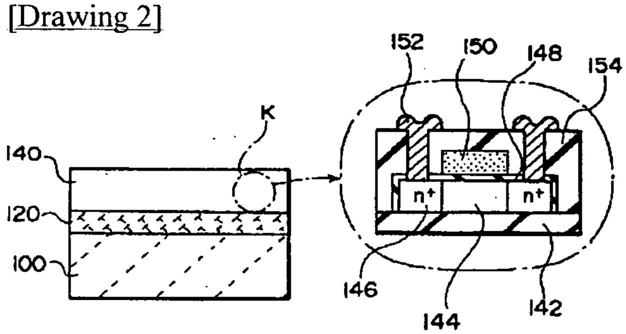
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

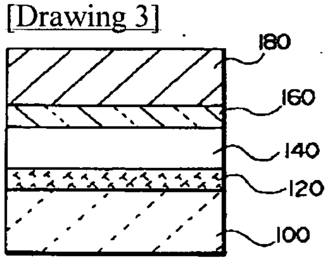
[Drawing 1]



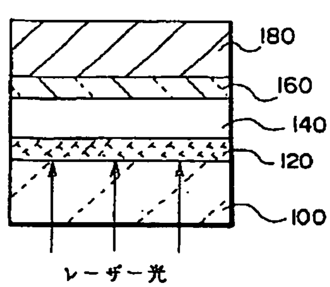
[Drawing 2]



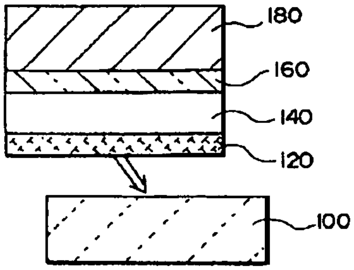
[Drawing 3]



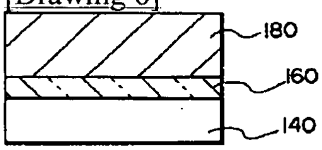
[Drawing 4]



[Drawing 5]



[Drawing 6]



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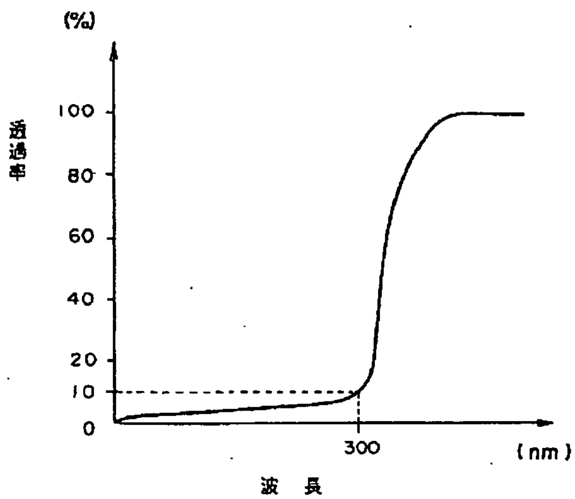

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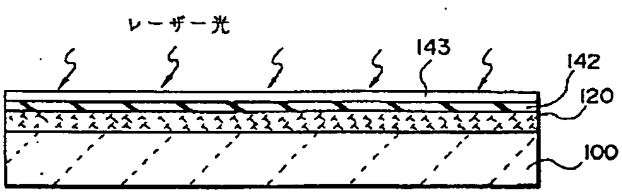

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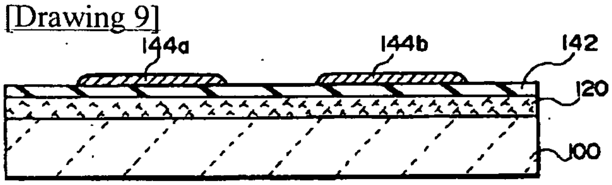

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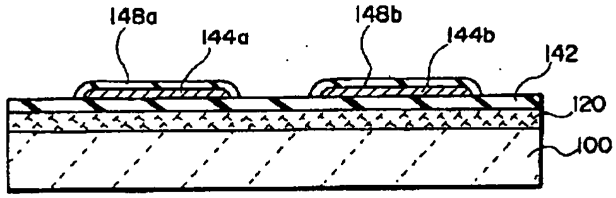

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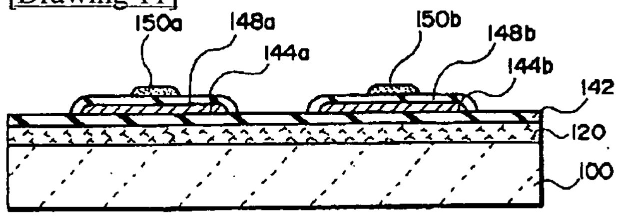

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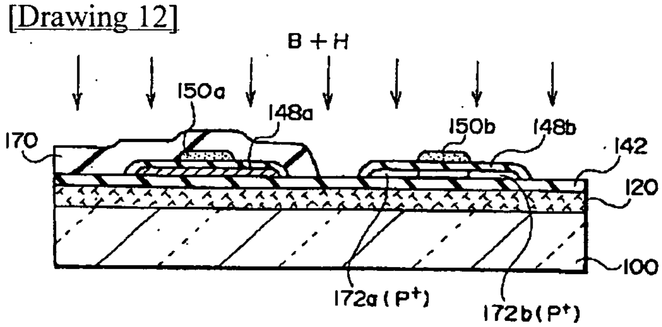
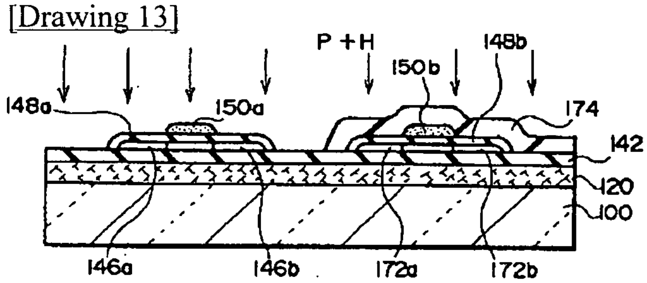


[Drawing 13]



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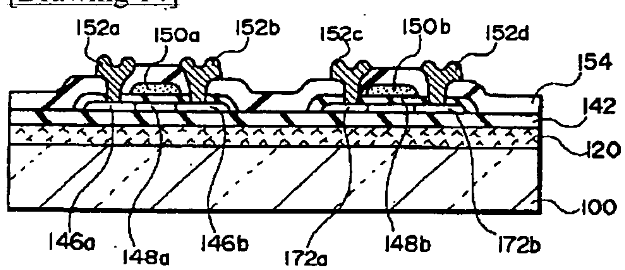

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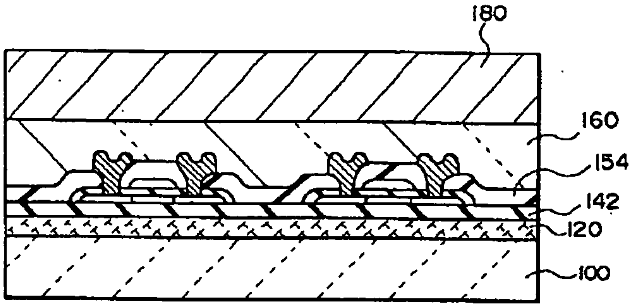

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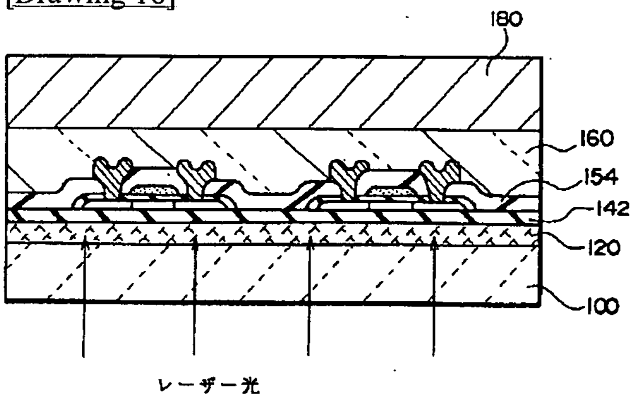

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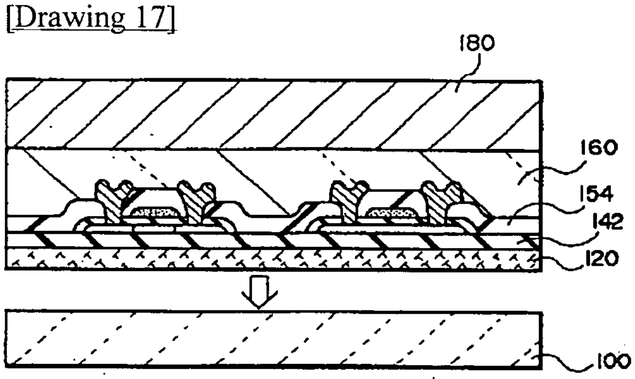

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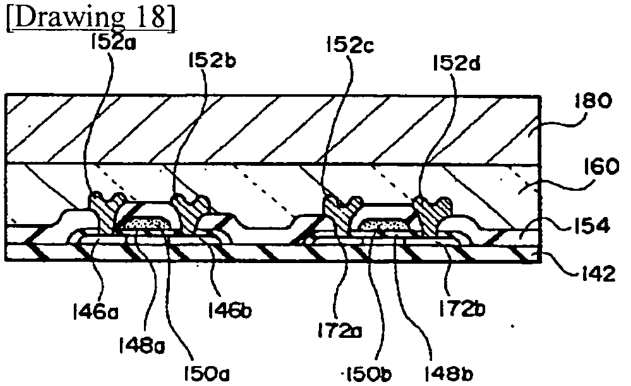

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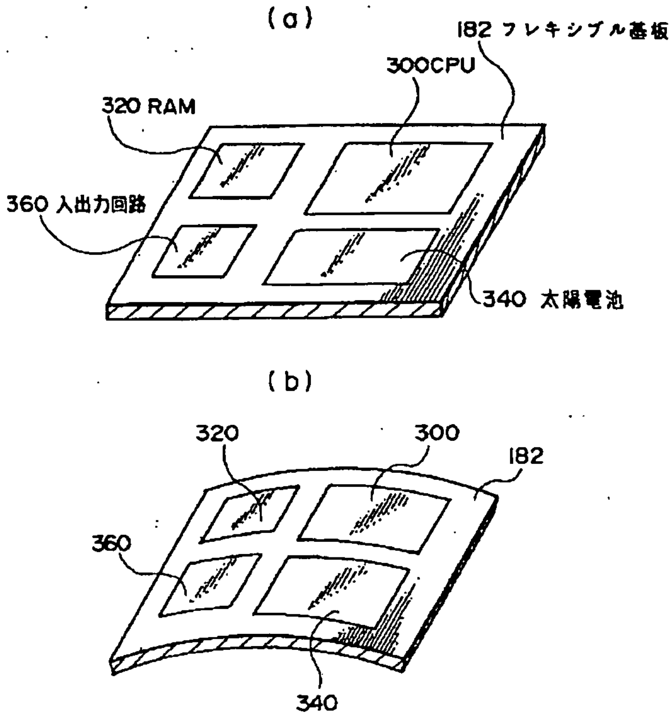

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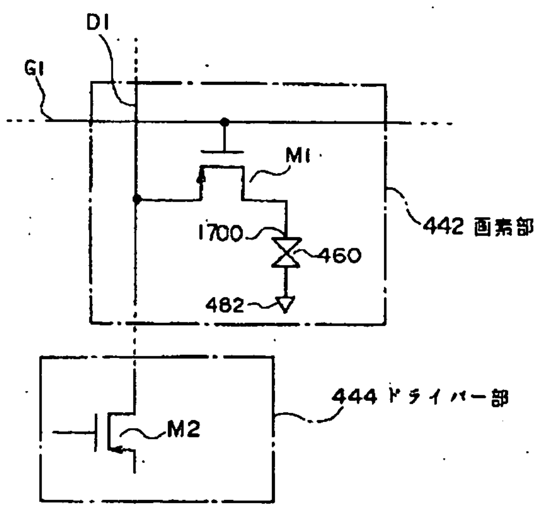

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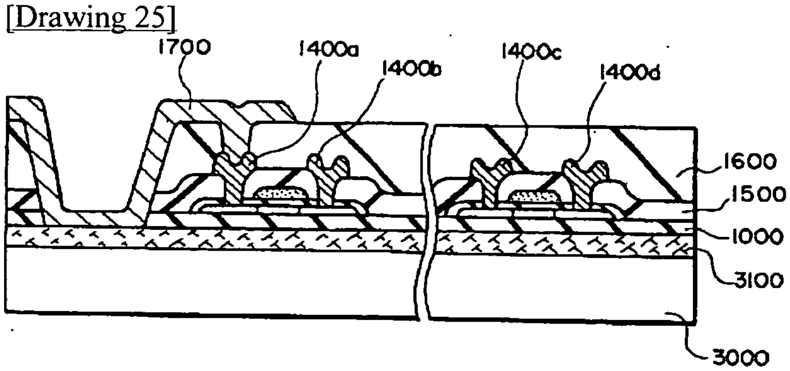

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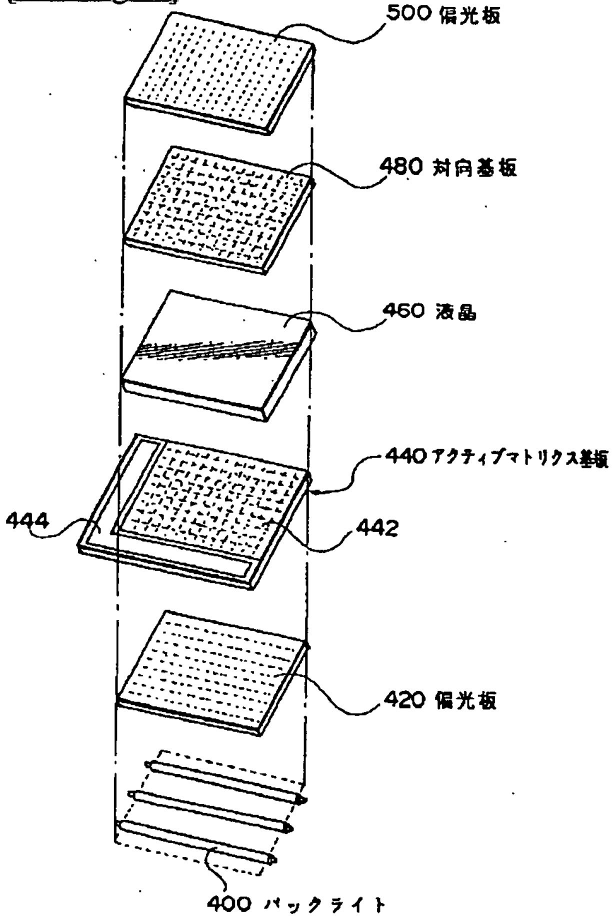

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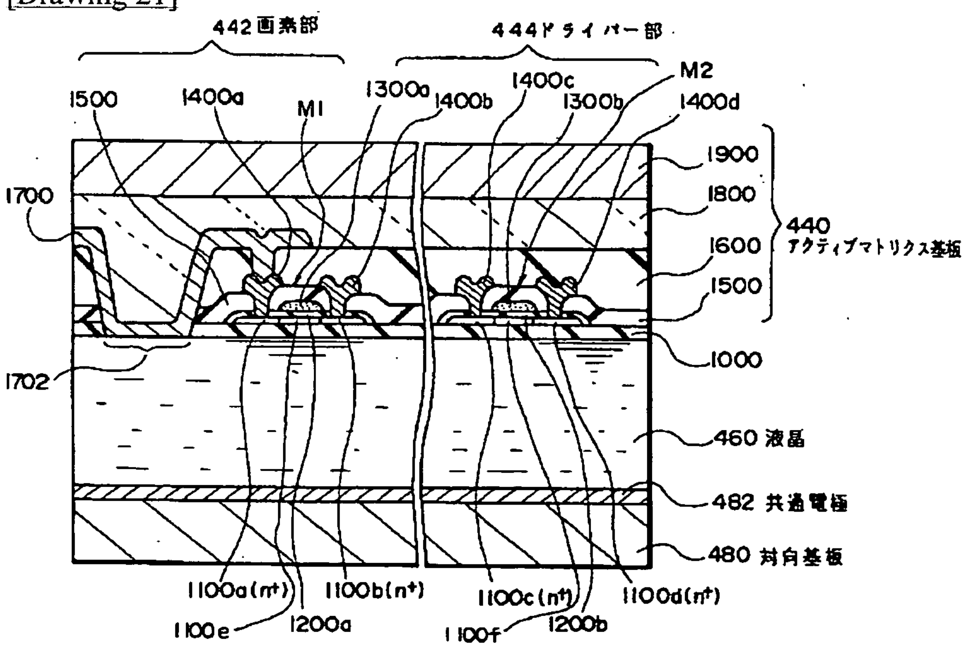

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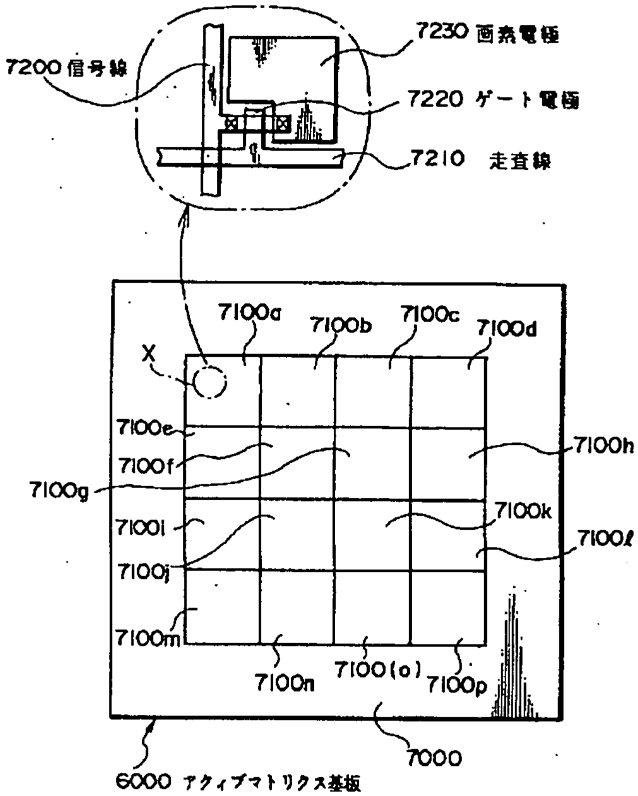

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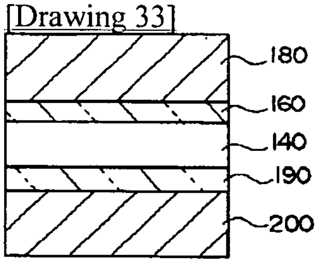
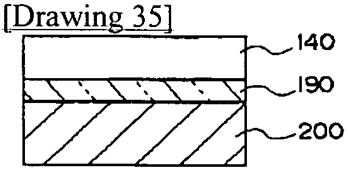


[Drawing 35]



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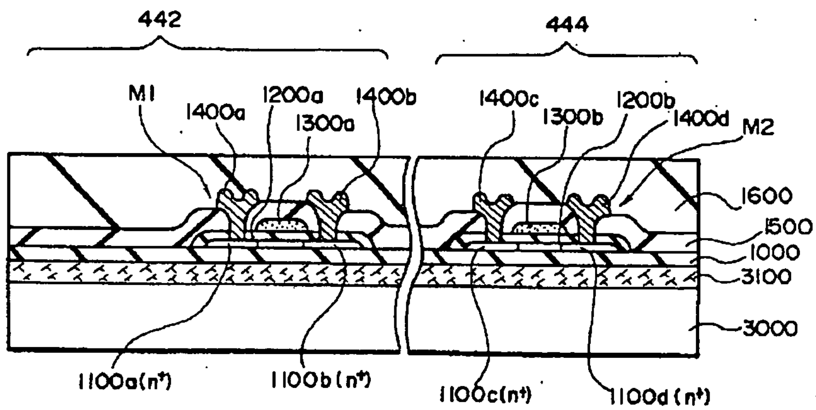

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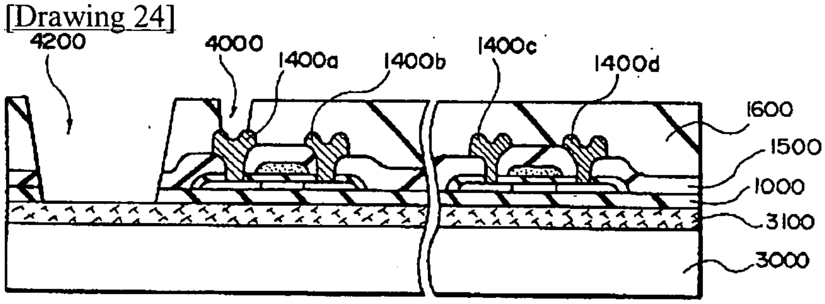
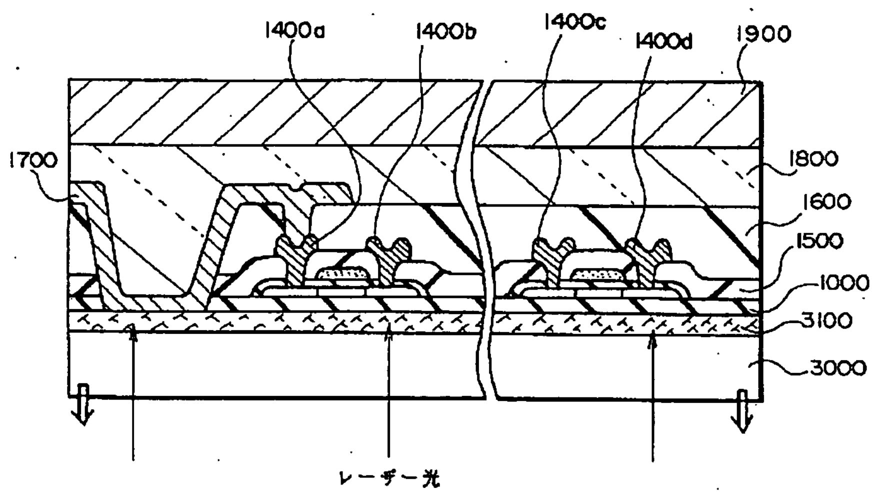


[Drawing 26]



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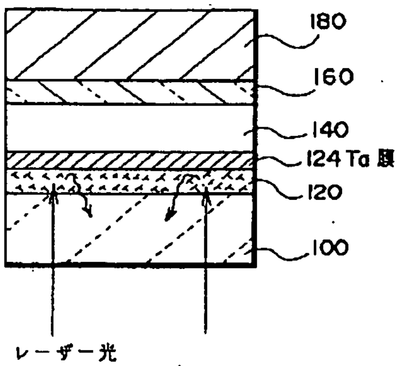

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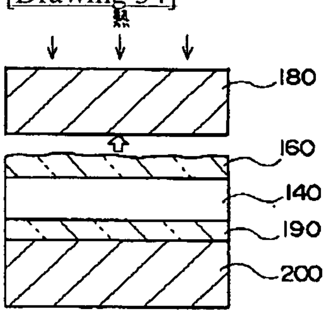

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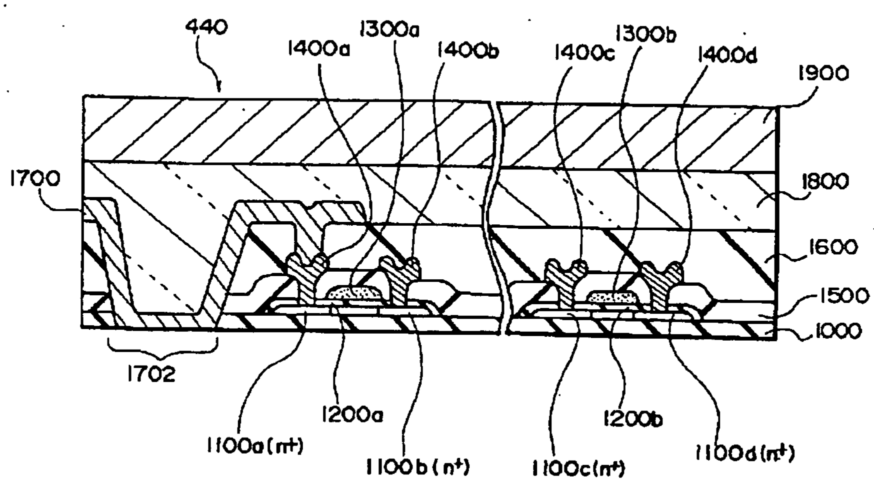

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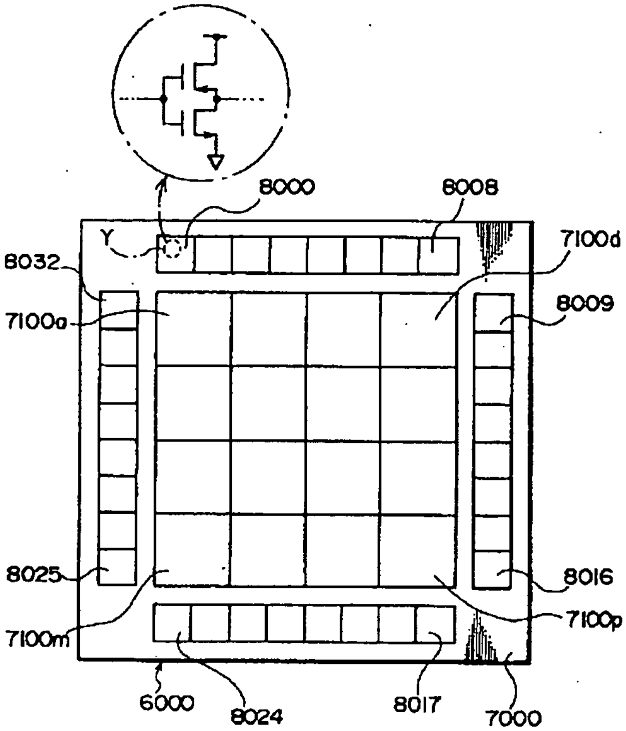
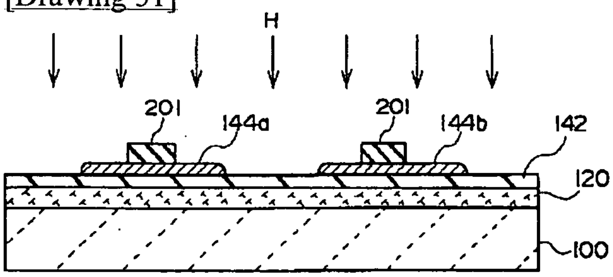
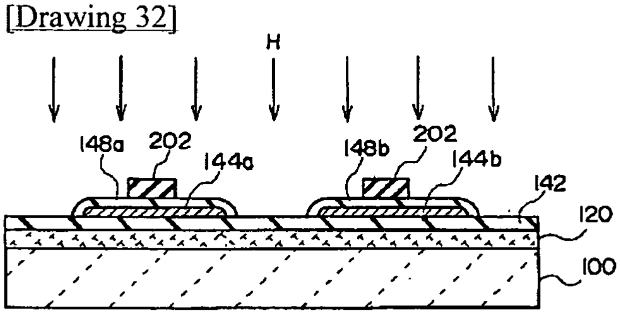


[Drawing 31]



[Drawing 32]



[Translation done.]

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-312811
(43)Date of publication of application : 09.11.1999

(51)Int.Cl. H01L 29/786
H01L 21/336
G02F 1/136

(21)Application number : 10-296216
(22)Date of filing : 02.10.1998

(71)Applicant : SEIKO EPSON CORP
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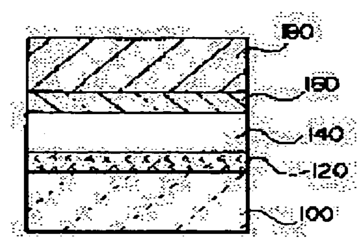
SHIMODA TATSUYA

(30)Priority
Priority number : 10 60594 Priority date : 25.02.1998 Priority country : JP

(54) THIN-FILM EXFOLIATION METHOD, THIN-FILM DEVICE TRANSFER METHOD, THIN-FILM DEVICE, ACTIVE MATRIX SUBSTRATE AND LIQUID CRYSTAL DISPLAYING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method, with which a thin-film device formed on a substrate can be exfoliated easily from the substrate.
SOLUTION: An isolation layer 120 is provided on a substrate 100, and a thin-film device 140 such as a TFT, etc., is formed thereon. Exfoliation accelerating ions such as hydrogen ions, for example, are injected into the isolated region 120, in the middle of the formation of the thin film device 140. After the thin- film device 140 has been formed, the thin-film device 140 is connected to a transfer member 180 via a bonded layer 160, and then a laser beam is made to irradiate from the side of the substrate. As a result, the isolation layer 120 is exfoliated, taking advantage of the action of the exfoliation acceleration ions. The thin film device 140 is made to exfoliate from the substrate 100. As a result, the desired thin-film device can be transferred to any type of substrate.



LEGAL STATUS

[Date of request for examination] 09.12.2003

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The 1st process which forms a detached core on a substrate, and the 2nd process which forms a thin film device on said detached core, The 3rd process which produces an exfoliation phenomenon in the inside of the layer of said detached core, and/or an interface, and makes said substrate exfoliate from said detached core, The exfoliation approach of the thin film device which is the exfoliation approach of a thin film device of ****(ing), and is characterized by preparing like ion grouting which pours ion into said detached core before said 3rd process.
[Claim 2] The exfoliation approach of the thin film device characterized by including the process which makes said ion poured into said detached core gasificate at said three processes in claim 1.
[Claim 3] It is the exfoliation approach of the thin film device characterized by including the process in which said 3rd process carries out an optical exposure in claim 2 at an account detached core.
[Claim 4] The exfoliation approach of the thin film device characterized by cutting association of the atom or molecule which constitutes said detached core like said ion grouting with said ion in claim 1 thru/or either of 3, and giving a damage beforehand to said detached core.
[Claim 5] The exfoliation approach of the thin film device characterized by changing the property of said detached core with said ion, and weakening the adhesion of said detached core and said substrate beforehand like said ion grouting in claim 1 thru/or either of 4.
[Claim 6] It is the exfoliation approach of the thin film device which said 2nd process has a thin film transistor formation process for forming a thin film transistor in claim 1 thru/or either of 5, and is characterized by carrying out said thin film transistor formation process after said channel layer formation process like said ion grouting including a channel layer formation process.
[Claim 7] It is the exfoliation approach of the thin film device characterized by carrying out said thin film transistor formation process after said channel pattern formation process like said ion grouting in claim 6 including a channel pattern formation process after said channel layer formation process.
[Claim 8] It is the exfoliation approach of the thin film device characterized by forming a mask among said channel layers like said ion grouting in claims 6 or 7 on a channel field and the becoming field, and carrying out.
[Claim 9] It is the exfoliation approach of the thin film device characterized by being the process in which said thin film transistor formation process forms gate dielectric film on this channel pattern after said channel pattern formation process in claim 7, and on this gate dielectric film, and carrying out like said ion grouting by using said gate electrode as a mask including said channel field and the process which forms a gate electrode in the field which counters.
[Claim 10] It is the exfoliation approach of the thin film device characterized by pouring into coincidence the impurity ion driven into either [at least] the source field in said channel pattern, or a drain field like said ion grouting in claims 8 or 9, and said ion which mass is lighter than it and is driven into said detached core.
[Claim 11] Like said ion grouting, it is the exfoliation approach of the thin film device characterized by carrying out in front of said crystallization process including the crystallization

process which said thin film transistor formation process carries out laser annealing of the process which forms an amorphous silicon layer as said channel layer, and its account amorphous silicon layer of back to front in claim 6, and is crystallized.
[Claim 12] It is the exfoliation approach of the thin film device characterized by said ion being a hydrogen ion in claim 1 thru/or either of 11.
[Claim 13] The exfoliation approach of the thin film device characterized by making into less than 350 degrees C process temperature of the process at which said ion grouting is carried out behind in claim 12.
[Claim 14] The thin film device which uses the exfoliation approach of ** for claim 1 thru/or either of 13, exfoliates from said substrate, and changes.
[Claim 15] The active-matrix substrate which is a active-matrix substrate with which the pixel section is constituted including the thin film transistor arranged in the shape of a matrix, and the pixel electrode connected to the end of the thin film transistor, and was manufactured by imprinting the thin film transistor of said pixel section using an approach according to claim 6 to 13.
[Claim 16] The liquid crystal display manufactured using the active-matrix substrate according to claim 15.
[Claim 17] The 1st process which forms the 1st detached core on a substrate, and the 2nd process which forms the transferred layer containing a thin film device on said 1st detached core, The 3rd process which forms the 2nd detached core which consists of water solubility or organic solvent melting nature adhesives on said transferred layer, It borders on said 1st detached core at the 4th process which joins a primary imprint object on said 2nd detached core. The 5th process which removes said substrate from said transferred layer, and the 6th process which joins a secondary imprint object to the inferior surface of tongue of said transferred layer, The imprint approach of the thin film device characterized by imprinting said transferred layer which said 2nd detached core is contacted to water or an organic solvent, has the 7th process which removes said primary imprint object from said transferred layer bordering on said 2nd detached core, and contains said thin film device on a secondary imprint object.
[Claim 18] The 1st process which forms the 1st detached core on a substrate, and the 2nd process which forms the transferred layer containing a thin film device on said 1st detached core, The 3rd process which forms the 2nd detached core which consists of the adhesives which have an exfoliation operation by heating or UV irradiation on said transferred layer, It borders on said 1st detached core at the 4th process which joins a primary imprint object on said 2nd detached core. The 5th process which removes said substrate from said transferred layer, and the 6th process which joins a secondary imprint object to the inferior surface of tongue of said transferred layer, The imprint approach of the thin film device characterized by imprinting said transferred layer which carries out UV irradiation, has heating or the 7th process which removes said primary imprint object from said transferred layer bordering on said 2nd detached core for said 2nd detached core, and contains said thin film device on a secondary imprint object.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the exfoliation approach of a thin film device, the imprint approach of a thin film device, a thin film device, a active-matrix substrate, and a liquid crystal display.
[0002]
[Background of the Invention] For example, it faces manufacturing the liquid crystal display using a thin film transistor (TFT), and passes through the process which forms a thin film transistor by CVD etc. on a substrate. Since the process which forms a thin film transistor on a substrate is accompanied by high temperature processing, a substrate needs to use what has the high thing, i.e., the softening temperature, and the high melting point of the quality of the material which is excellent in thermal resistance. Therefore, in current, quartz glass is used as a substrate which bears the temperature of about 1000 degrees C, and heat-resisting glass is used as a substrate which bears the temperature around 500 degrees C.
[0003] As mentioned above, the substrate carrying a thin film device must satisfy the conditions for manufacturing those thin film devices. That is, it is determined that the substrate to be used will surely fulfill the manufacture conditions of the device carried.
[0004] However, when its attention is paid only to the phase after the substrate carrying thin film devices, such as TFT, is completed, above-mentioned "substrate" is not sometimes necessarily desirable.
[0005] For example, although a quartz substrate, a heat-resisting glass substrate, etc. are used as mentioned above when passing through the manufacture process accompanied by high temperature processing, these are very expensive, therefore cause the rise of a product price.
[0006] Moreover, a glass substrate has the property for it to be heavy and to be easy to be divided. Although what cannot break easily even if it is cheap as much as possible, it is light and it bears and drops also on deformation of some with the liquid crystal display used for portable electronic devices, such as a palmtop computer and a portable telephone, is desirable, actually, a glass substrate is heavy, and is weak to deformation, and it is common that there is fear of destruction by fall.
[0007] That is, it was very difficult for a slot to be between the desirable properties required of the constraint which comes from manufacture conditions, and a product, and to satisfy the conditions and property of these both sides to it.
[0008] Then, an applicant for this patent has proposed the technique of exfoliating from the 1st substrate and making the 2nd substrate imprinting this thin film device, after forming a thin film device on the 1st substrate in the conventional process (Japanese Patent Application No. No. 225643 [eight to]). For this reason, the detached core is formed between the 1st substrate and the thin film device which is a transferred layer. The thin film device which is a transferred layer is made to exfoliate from the 1st substrate, and this transferred layer is made to imprint to a 2nd substrate side by irradiating light at this detached core.
[0009]
[Problem(s) to be Solved by the Invention] According to the experiment of this invention person,

when making a thin film device exfoliate from the 1st substrate, it was discovered that an exfoliation phenomenon may not fully arise in a detached core only by irradiating light at a detached core.
[0010] And it became clear that it was [of this invention person] dependent on the property of a detached core wholeheartedly whether it is easy to produce this exfoliation phenomenon according to research.
[0011] Furthermore, the technical problem that it will differ mutually had the laminating relation of the transferred layer to the 1st substrate used when manufacturing a transferred layer, and the laminating relation of the transferred layer to the 2nd substrate which is the imprint place of the transferred layer.
[0012] Then, this invention is to offer the thin film device, active-matrix substrate, and liquid crystal display which use it for the exfoliation approach list of a thin film device compensate [list] that it will be in the condition that a detached core tends to exfoliate, and it was made to make a thin film device exfoliate easily from a substrate, and are manufactured in front of the process which makes a detached core produce an exfoliation phenomenon in exfoliation.
[0013] Other purposes of this invention are to offer the imprint approach of the thin film device which can make in agreement the laminating relation of the transferred layer to the substrate used at the time of manufacture of a transferred layer, and the laminating relation of the transferred layer to the imprint object which is the imprint place of the transferred layer.
[0014]
[Means for Solving the Problem] The 1st process at which invention according to claim 1 forms a detached core on a substrate, and the 2nd process which forms a thin film device on said detached core, An exfoliation phenomenon is produced in the inside of the layer of said detached core, and/or an interface, and it is characterized by preparing like ion grouting which pours ion into said detached core before said 3rd process in the exfoliation approach of a thin film device of having the 3rd process which makes said substrate exfoliating from said detached core.
[0015] The detached core which has the property which absorbs light that the dependability in device manufacture is high, on substrates, such as a quartz substrate, is prepared, for example, and thin film devices, such as TFT, are formed on the substrate. It joins to the imprint object of a request of a thin film device through the glue line preferably next. Light is irradiated after that at a detached core, and it produces and cheats out of an exfoliation phenomenon in the detached core. Thereby, a thin film device can be made to exfoliate from a substrate by applying the force to a substrate.
[0016] The exfoliation phenomenon of the detached core in an exfoliation process can become remarkable, and a thin film device can be made to exfoliate from a substrate certainly by pouring ion into a detached core in front of an exfoliation process at this time.
[0017] Here, by pouring ion into a detached core beforehand, the operation defined as either of claims 2-5 is made, and the exfoliation phenomenon of a detached core becomes remarkable.
[0018] According to claim 2, the process by which said ion poured into said detached core is gasificated is included in said three processes. If the ion in a detached core is gasificated, in a detached core, internal pressure will arise and the exfoliation phenomenon will be promoted.
[0019] In this case, light can be irradiated at a detached core and the ion for exfoliation can be made to gasificate by that light, as shown in claim 3. If an optical exposure is carried out at this time [side / of a substrate / rear-face], the quantity of light by which optical incidence is carried out to a thin film device layer can be reduced, and degradation of that property can be prevented.
[0020] According to claim 4, like said ion grouting, association of the atom or molecule which constitutes said detached core with said ion is cut, and a damage is beforehand given to said detached core. Therefore, the exfoliation phenomenon in the detached core produced at a subsequent exfoliation process is promoted.
[0021] According to claim 5, like said ion grouting, the property of said detached core is changed with said ion, and the adhesion of said detached core and said substrate is weakened beforehand. Therefore, the exfoliation phenomenon in the detached core produced at a subsequent exfoliation process is promoted.

[0022] Invention of claim 6 has a thin film transistor formation process for said 2nd process to form a thin film transistor in claim 1 thru/or either of 5, and said thin film transistor formation process is characterized by carrying out after said channel layer formation process like said ion grouting including a channel layer formation process.
[0023] A channel formation process turns into a high-temperature-processing process as compared with other processes. Therefore, it is because there is a possibility that ion may be emitted from a detached core at the time of subsequent high temperature processing when the ion for exfoliation phenomenon promotion is poured in before that at the detached core.
[0024] Invention of claim 7 is characterized by carrying out said thin film transistor formation process after said channel pattern formation process like said ion grouting including a channel pattern formation process after said channel layer formation process in claim 6.
[0025] If the channel pattern is formed, even if it pours in the ion for exfoliation phenomenon promotion from a channel pattern side, the area of the channel pattern itself which can serve as a failure of the impregnation will decrease. Therefore, it becomes that it is easy to make ion reach to a detached core.
[0026] Invention of claim 8 is characterized by forming a mask among said channel layers on a channel field and the becoming field, and carrying out like said ion grouting in claims 6 or 7.
[0027] It is because there is a possibility that transistor characteristics may deteriorate when ion is poured into a channel field. In addition, the process which carries out the mask of the channel field and carries out an ion implantation may be before channel pattern formation or after formation.
[0028] In claim 9, said thin film transistor formation process is characterized by carrying out like said ion grouting by using said gate electrode as a mask after said channel pattern formation process including the process which forms gate dielectric film on this channel pattern, and the process which forms a gate electrode on this gate dielectric film in claim 7.
[0029] Since a gate electrode is formed in a channel and the location which counters, a gate electrode can be used also [field / channel] as a mask with which ion prevents pouring into a channel field. In addition, according to the acceleration voltage of ion, a mask may be further formed on a gate electrode.
[0030] Invention of claim 10 is characterized by pouring into coincidence the impurity ion driven into either [at least] the source field in said channel pattern, or a drain field, and said ion which mass is lighter than it and is driven into said detached core like said ion grouting in claims 8 or 9.

[0031] If it carries out like this, it can be made to serve a double purpose like impurity ion grouting to the source and/or a drain field like ion grouting to a detached core. In addition, since mass is lighter than impurity ion, ion can reach to the detached core in a location deeper than the source and a drain field.
[0032] Invention of claim 11 is characterized by carrying out said thin film transistor formation process in front of said crystallization process like said ion grouting including the process which forms an amorphous silicon layer as said channel layer, and the crystallization process which carries out laser annealing of the account amorphous silicon layer of back to front, and is crystallized in claim 6.
[0033] Crystallinity is raised by the subsequent laser annealing process even if a damage should arise in a channel layer by operation like ion grouting.
[0034] Invention of claim 12 is characterized by said ion being a hydrogen ion in claim 1 thru/or either of 11.
[0035] If a hydrogen ion is poured into a detached core, it can be made to contribute to the operation shown in each of claims 2-4. Since mass is lighter than the source and the impurity ion (boron, Lynn, etc.) driven into a drain, especially the hydrogen ion also fits implementation of invention of claim 9. In addition, as ion which mainly produces gasification of claim 2, nitrogen ion etc. can be mentioned other than a hydrogen ion. Moreover, as ion which mainly produces the damage of claims 3 and 4, or an adhesion fall, Si ion etc. can be mentioned other than a hydrogen ion.
[0036] Invention of claim 13 is characterized by said ion grouting making process temperature of

the process carried out behind less than 350 degrees C in claim 12.
[0037] Since it begins to escape from the hydrogen poured into the detached core by being heated by 350 degrees C or more, as for the process which needs the process temperature of 350 degrees C or more, it is as desirable as ion grouting to a detached core to carry out in front.

[0038] Invention of claim 14 defines the thin film device which uses the exfoliation approach of ** for claim 1 thru/or either of 13, exfoliates from said substrate, and changes. Since the exfoliation from a detached core is easy for this thin film device, there is little mechanical pressure which acts at the time of exfoliation, it ends, and can lessen the defect depending on the magnitude of that load.
[0039] Invention of claim 15 is a active-matrix substrate with which the pixel section is constituted including the thin film transistor arranged in the shape of a matrix, and the pixel electrode connected to the end of the thin film transistor, and defines the active-matrix substrate manufactured by imprinting the thin film transistor of said pixel section using an approach according to claim 6 to 13.
[0040] This active-matrix substrate as well as invention of claim 13 can lessen a defect.
[0041] Invention of claim 16 defines the liquid crystal display manufactured using the active-matrix substrate according to claim 15.
[0042] Since the active-matrix substrate of claim 15 is used for this liquid crystal display, its defect as the whole liquid crystal display also decreases.
[0043] The imprint approach of the thin film device concerning invention of claim 17 The 1st process which forms the 1st detached core on a substrate, and the 2nd process which forms the transferred layer containing a thin film device on said 1st detached core, The 3rd process which forms the 2nd detached core which consists of water solubility or organic solvent melting nature adhesives on said transferred layer, It borders on said 1st detached core at the 4th process which joins a primary imprint object on said 2nd detached core. The 5th process which removes said substrate from said transferred layer, and the 6th process which joins a secondary imprint object to the inferior surface of tongue of said transferred layer, Said 2nd detached core is contacted to water or an organic solvent, and it has the 7th process which removes said primary imprint object from said transferred layer bordering on said 2nd detached core, and is characterized by imprinting said transferred layer containing said thin film device on a secondary imprint object.
[0044] After removing the 1st detached core and joining a secondary imprint object to the inferior surface of tongue from the inferior surface of tongue of a transferred layer, it is made to secede from a primary imprint object from a transferred layer bordering on the 2nd detached core according to invention of claim 17. If it carries out like this, a secondary imprint object will exist in the location in which the original substrate was located to a transferred layer, and the laminating relation of the transferred layer to the original substrate and the laminating relation of the transferred layer to a secondary imprint object are in agreement. here, since water-soluble adhesives or organic solvent melting nature adhesives is used as the 2nd detached core, the 2nd detached core is contacted to water or an organic solvent making it secede from a primary imprint object — being sufficient .
[0045] By the imprint approach of the thin film device concerning invention of claim 18, as the 2nd detached core under approach invention of claim 17, it replaces with the above-mentioned adhesives and the adhesives which can exfoliate by heating or ultraviolet rays are used.
[0046] In this case, if the 2nd detached core is contacted in the adhesives which can exfoliate by heating or ultraviolet rays making it secede from a primary imprint object, the laminating relation of the transferred layer to the original substrate and the laminating relation of the transferred layer to a secondary imprint object can be made in agreement like invention of claim 17.
[0047]
[Embodiment of the Invention] Next, the gestalt of operation of this invention is explained with reference to a drawing.
[0048] <Gestalt of the 1st operation> drawing 1 - drawing 6 are drawings for explaining the

imprint approach of the thin film device which will be the requisite for this invention.
[0049] As shown in [process 1] drawing 1 , a detached core (light absorption layer) 120 is formed on a substrate 100.
[0050] Hereafter, a substrate 100 and a detached core 120 are explained.
[0051] ** What has the translucency which light may penetrate is used for the explanation substrate 100 about a substrate 100.
[0052] In this case, as for the permeability of light, it is desirable that it is 10% or more, and it is more desirable that it is 50% or more. When this permeability is too low, attenuation (loss) of light becomes large and needs the big quantity of light by exfoliating a detached core 120.
[0053] Moreover, as for a substrate 100, it is desirable to consist of reliable ingredients, and it is desirable to consist of ingredients which were excellent in thermal resistance especially. Although the reason has what process temperature becomes high depending on the class and formation approach (for example, about 350-1000 degrees C) in case it forms the transferred layer 140 and interlayer 142 who mention later, it is because the width of face of a setup of membrane formation conditions, such as the temperature condition, will spread even in such a case on the occasion of formation of the transferred layer 140 grade to a substrate 100 top if the substrate 100 is excellent in thermal resistance.
[0054] Therefore, a substrate 100 has a desirable consisting-of [the strain point]-ingredients more than Tmax thing, when the maximum temperature in the case of formation of the transferred layer 140 is set to Tmax. A thing 350 degrees C or more has a desirable strain point, and, specifically, the component of a substrate 100 has a more desirable thing 500 degrees C or more. As such a thing, the heat resisting glass of quartz glass, Corning 7059, and NEC glass OA-2 grade is mentioned, for example.
[0055] Moreover, although especially the thickness of a substrate 100 is not limited, it is desirable that it is about 0.1-5.0mm, and it is usually more desirable that it is about 0.5-1.5mm. If the thickness of a substrate 100 is too thin, a strong fall will be caused, and if too thick, when the permeability of a substrate 100 is low, it will become easy to produce attenuation of light. In addition, when the permeability of the light of a substrate 100 is high, the thickness may exceed said upper limit. In addition, as for the thickness of a substrate 100, it is desirable that it is uniform so that light can be irradiated at homogeneity.
[0056] ** The explanation detached core 120 of a detached core 120 is receiving any one or two or more operations of physical operations (light, heat, etc.), chemical operations (chemical reaction with a drug solution etc.), or mechanical works (hauling force, vibration, etc.), that bonding strength is decreased or extinguished and this urges separation of a substrate 100 to it through this detached core 120.
[0057] The light which it considers as this detached core 120, for example, is irradiated can be absorbed, and what has a property which produces exfoliation (henceforth "exfoliation in a layer" and "interfacial peeling") in the inside of that layer and/or an interface can be mentioned. What it arises that the bonding strength between the atoms of the matter which constitutes a detached core 120, or between molecules disappears or decreases, i.e., ablation, and results in the exfoliation in a layer and/or interfacial peeling by the exposure of light preferably is good.
[0058] Furthermore, a gas may be emitted by the exposure of light from a detached core 120, and the separation effectiveness may be discovered. That is, a detached core 120 absorbs light, it becomes a gas to the case where the component contained in the detached core 120 serves as a gas, and it is emitted for a moment, the steam is emitted, and it may contribute to separation.
[0059] In this invention, after forming the detached core 120 which has such a property, it is the description to pour in the ion for exfoliation promotion into a detached core 120, and, thereby, the exfoliation phenomenon in the detached core 120 in a subsequent process is promoted. Therefore, a class will not be asked if the exfoliation phenomenon by the physical operation, chemical operation, or mechanical work mentioned above is promoted as ion for exfoliation promotion.
[0060] Next, as a presentation of such a detached core 120, what is indicated by following A-E is mentioned, for example.

[0061] A. Amorphous silicon (a-Si)
Hydrogen (H) may contain in this amorphous silicon. In this case, as for the content of H, it is desirable that it is extent more than 2 atom %, and it is more desirable that it is 2 - 20 atom % extent. Thus, if specified quantity content of the hydrogen (H) is carried out, by making light an exposure behind, hydrogen will be emitted, internal pressure will occur in a detached core 120, and it will become the force in which it exfoliates an up-and-down thin film. The content of the hydrogen in an amorphous silicon (H) can be adjusted by setting up suitably conditions, such as membrane formation conditions, for example, the gas presentation in CVD, gas pressure, a gas ambient atmosphere, a quantity of gas flow, temperature, substrate temperature, and injection power.
[0062] With the gestalt of this operation, the ion implantation of the hydrogen ion can be carried out as ion for exfoliation promotion at one after formation of an amorphous silicon layer of stages as hydrogen is made to contain in a detached core 120 according to this process condition and also being mentioned later. Thereby, the hydrogen more than a constant rate can be made to contain in an amorphous silicon layer, without being influenced by the process conditions of an amorphous silicon.
[0063] B. As various oxide ceramics, such as silicon oxide or a silicic-acid compound, titanium oxide or a titanic-acid compound, a zirconium dioxide or a zirconic acid compound, a lanthanum trioxide, or a lanthanum oxidation compound, ****** (ferroelectric), or semi-conductor silicon oxide, SiO, SiO2, and Si 3O2 are mentioned, and K2SiO3, Li2SiO3, CaSiO3 and ZrSiO4, and Na2SiO3 are mentioned as a silicic-acid compound, for example.
[0064] TiO, Ti2O3, and TiO2 mention as titanium oxide — having — as a titanic-acid compound -- BaTiO4, BaTiO3, Ba2Ti 9O20, BaTi 5O11, and CaTiO3, SrTiO3, PbTiO3, MgTiO3, ZrTiO2, SnTiO4 and aluminum2 — TiO5 and FeTiO3 are mentioned.
[0065] As a zirconium dioxide, ZrO2 is mentioned and BaZrO3, ZrSiO4, PbZrO3, MgZrO3, and K2ZrO3 are mentioned as a zirconic acid compound, for example.
[0066] C. The ceramics or dielectrics (ferroelectric), such as PZT, PLZT, PLLZT, and PBZT
D. As nitride-ceramics E. organic polymeric-materials organic polymeric materials, such as silicon nitride, nitriding aluminum, and titanium nitride - CH-, -CO- (ketone), -CONH- (amide), -NH- (imide), - As long as it is what has association (these association is cut by the exposure of light) of COO- (ester), -N=N- (azo), -CH=N- (CIF), etc., and the thing which has many these association especially, what kind of thing may be used. Moreover, organic polymeric materials may have aromatic hydrocarbon (1, two or more benzene rings, or condensed ring of those) in a constructive mood.
[0067] As an example of such organic polymeric materials, polyethylene, polyolefine like polypropylene, polyimide, a polyamide, polyester, polymethylmethacrylate (PMMA), polyphenylene sulfide (PPS), polyether sulphone (PES), an epoxy resin, etc. are raised.
[0068] F. As a metal metal, the alloy containing at least one of aluminum, Li, Ti, Mn, In, Sn, Y, La, Ce, Nd, Pr, Gd, Sm, or sorts of these is mentioned, for example.
[0069] Moreover, although the thickness of a detached core 120 changes with terms and conditions, such as a presentation of the exfoliation purpose or a detached core 120, lamination, and the formation approach, it is desirable that it is 1nm - about 20 micrometers, it is more desirable that it is 5nm - about 2 micrometers, and it is usually still more desirable [thickness] that it is 5nm - about 1 micrometer. While enlarging power (quantity of light) of light in order to secure the good detachability of a detached core 120 if the homogeneity of membrane formation is spoiled, nonuniformity may arise in exfoliation, when the thickness of a detached core 120 is too small, and thickness is too thick, in case a detached core 120 is removed behind, the activity takes time amount. In addition, as for the thickness of a detached core 120, it is desirable that it is uniform as much as possible.
[0070] Especially the formation approach of a detached core 120 is not limited, but is suitably chosen according to terms and conditions, such as a film presentation and thickness. For example, it CVD(s) (MOCVD and low voltage — CVD and ECR-CVD are included). Vacuum evaporationo, molecular beam deposition (MB), sputtering, ion plating, The various gaseous-phase forming-membranes methods, such as PVD, electroplating, immersion plating (dipping),

various plating, such as electroless deposition, and the Langmuir pro jet (LB) — law — The applying methods, such as a spin coat, a spray coat, and a roll coat, various print processes, a replica method, the ink jet method, a powder jet process, etc. are mentioned, and it can also form or more [of these] combining two.
[0071] For example, when the presentation of a detached core 120 is an amorphous silicon (a-Si), it is desirable to form membranes by CVD especially low voltage CVD, or plasma CVD.
[0072] Moreover, when a detached core 120 is constituted from ceramics by the sol-gel method, or when it constitutes from organic polymeric materials, it is desirable the applying method and to form membranes with a spin coat especially.
[0073] As shown in [a process 2], next drawing 2 , the transferred layer (thin film device layer) 140 is formed on a detached core 120. Although the detail after this process 2 is later explained with reference to drawing 8 - drawing 18 , it is carrying out like ion grouting for exfoliation promotion to a detached core 120 with the gestalt of this operation in the middle of the process of drawing 8 - drawing 13 .
[0074] The expanded sectional view of K part (part shown by surrounding with 1 dotted-line chain line in drawing 2) of this thin film device layer 140 is shown in the right-hand side of drawing 2 . It is constituted including TFT (thin film transistor) formed on Si02 film (middle class) 142, and the thin film device layer 140 possesses the source and the drain layer 146 which this TFT introduced n mold impurity into the polish recon layer, and were formed, the channel layer 144, gate dielectric film 148, the gate electrode 150, an interlayer insulation film 154, and the electrode 152 that consists of aluminum so that it may be illustrated.
[0075] Although Si02 film is used with the gestalt of this operation as an interlayer prepared in contact with a detached core 120, the insulator layer of others, such as Si3N4, can also be used. Although the thickness of Si02 film (interlayer) is suitably determined according to the formation purpose or extent of a function which can be demonstrated, it is desirable that it is 10nm - about 5 micrometers, and it is usually more desirable that it is 40nm - about 1 micrometer. What demonstrates at least one of the functions as the protective layer which an interlayer is formed for the various purpose, for example, protects the transferred layer 140 physically or chemically, an insulating layer, a conductive layer, the protection-from-light layer of laser light, the barrier layer for migration prevention, and a reflecting layer is mentioned.
[0076] In addition, the middle class, such as Si02 film, may not be formed depending on the case, but the direct transferred layer (thin film device layer) 140 may be formed on a detached core 120.
[0077] The transferred layer 140 (thin film device layer) is a layer containing thin film devices, such as TFT as shown in the right-hand side of drawing 2 .
[0078] As a thin film device, besides TFT, for example, a thin-film diode, The optoelectric transducer (the photosensor, solar battery) and silicon resistance element which consist of PIN junction of silicon, Other thin film semiconductor devices, an electrode (example: a transparent electrode like ITO and the mesa film), Actuators, such as a switching element, memory, and a piezoelectric device, a micro mirror (piezo thin film ceramics), There are a micro MAG device which combined a magnetic-recording thin film head, a coil, an inductor, the charge of a thin film quantity magnetic-permiable material, and them, a filter, reflective film, a dichroic mirror, etc.
[0079] Such a thin film device is formed through usually comparatively high process temperature by relation with the formation approach. Therefore, as mentioned above in this case, as a substrate 100, the thing which has high dependability and which can bear that process temperature is needed.
[0080] As shown in [a process 3], next drawing 3 , the thin film device layer 140 is joined to the imprint object 180 through a glue line 160 (adhesion).
[0081] As a suitable example of the adhesives which constitute a glue line 160, various hardening mold adhesives, such as photo-curing mold adhesives, such as reaction hardening mold adhesives, heat-curing mold adhesives, and ultraviolet curing mold adhesives, and aversion hardening mold adhesives, are mentioned. As a presentation of adhesives, what kind of thing is sufficient as an epoxy system, an acrylate system, a silicone system, etc., for example. Formation of such a glue line 160 is made for example, by the applying method.

[0082] After applying hardening mold adhesives on the transferred layer (thin film device layer) 140 and joining the imprint object 180 on it when using said hardening mold adhesives for example, said hardening mold adhesives are stiffened by the hardening approach according to the property of hardening mold adhesives, and the transferred layer (thin film device layer) 140 and the imprint object 180 are pasted up, and it fixes. [0083] when adhesives are photo-curing molds, light is irradiated from the substrate of light transmission nature, and both the outsides of an imprint object or — from one outside of the substrate 100 of light transmission nature, or the imprint object 180 of light transmission nature. As adhesives, photo-curing mold adhesives, such as an ultraviolet curing mold which cannot affect a thin film device layer easily, are desirable.
[0084] Water-soluble adhesives can also be used as a glue line 160. As this kind of water-soluble adhesives, it is KEMISHIRU made from for example, KEMITEKKU, Inc. Three Bond 3046 (trade name) by U-451D (trade name) and Three Bond Co., Ltd. etc. can be mentioned.
[0085] The adhesives which have melting nature to various kinds of organic solvents as a glue line 160 can also be used.
[0086] As a glue line 160, the adhesives which present an exfoliation operation with heating can also be used. As this kind of adhesives, RIBAARUFA made from for example, Japanese east DENKO (trade name) can be used.
[0087] As a glue line 160, the adhesives which present an exfoliation operation by UV irradiation can also be used. As this kind of adhesives, the dicing tape D-210 for glass ceramics by LINTEC Corp. and D-636 can be used.
[0088] In addition, unlike illustration, a glue line 160 may be formed in the imprint object 180 side, and the transferred layer (thin film device layer) 140 may be pasted up on it. In addition, when imprint object 180 the very thing has an adhesion function, for example, formation of a glue line 160 may be omitted.
[0089] although not limited especially as an imprint object 180 — a substrate (plate) — especially a transparence substrate is mentioned. In addition, such a substrate may be monotonous or may be a curve plate. Moreover, compared with said substrate 100, properties, such as thermal resistance and corrosion resistance, may be inferior in the imprint object 180. It is because the reason forms the transferred layer (thin film device layer) 140 in a substrate 100 side in this invention, and imprints the transferred layer (thin film device layer) 140 on the imprint object 180 after that, so it does not depend on the temperature conditions in the case of formation of the transferred layer (thin film device layer) 140 etc. for the property required of the imprint object 180, especially thermal resistance.
[0090] Therefore, when the maximum temperature in the case of formation of the transferred layer 140 is set to Tmax, a glass transition point (Tg) or softening temperature can use the following [Tmax] as a component of the imprint object 0. For example, a glass transition point (Tg) or softening temperature can constitute more preferably 800 degrees C or less of 500 degrees C or less of imprint objects 180 from an ingredient 320 degrees C or less still more preferably.
[0091] Moreover, although what has a certain amount of rigidity (reinforcement) as a mechanical property of the imprint object 180 is desirable, you may have flexibility and elasticity.
[0092] As a component of such an imprint object 180, various synthetic resin or various glass material are mentioned, and various synthetic resin and the usual cheap glass material (low melting point) are desirable especially.
[0093] As synthetic resin, any of thermoplastics and thermosetting resin are sufficient. For example, polyethylene, a polo propylene, an ethylene-pre pyrene copolymer, Polyolefines, such as an ethylene-vinylacetate copolymer (EVA), annular polyolefine, Denaturation polyolefine, a polyvinyl chloride, a polyvinylidene chloride, polystyrene, A polyamide, polyimide, polyamidoimide, a polycarbonate, Polly (4-methyl BENTEN -1), An ionomer, acrylic resin, polymethylmethacrylate, an acrylic-styrene copolymer (AS resin), Butadiene Styrene, a polio copolymer (EVOH), polyethylene terephthalate (PET), Polyester, such as polyp CHIREN terephthalate (PBT) and PURISHI clo hexane terephthalate (PCT), A polyether, a polyether ketone (PEK), a polyether ether ketone (PEEK), Polyether imide, polyacetal (POM), polyphenylene oxide, Denaturation polyphenylene oxide, polyarylate, aromatic polyester (liquid crystal polymer),

Polytetrafluoroethylene, polyvinylidene fluoride, other fluorine system resin, A styrene system, a polyolefine system, a polyvinyl chloride system, a polyurethane system, Various thermoplastic elastomer, such as a fluororubber system and a chlorinated polyethylene system, EBOKISHI resin, phenol resin, a urea resin, melamine resin, unsaturated polyester, The copolymer which is mainly concerned with these, a blend object, a polymer alloy, etc. are mentioned, and silicone resin, polyurethane, etc. can be used combining 1 of sorts of these, and two sorts or more (as a layered product for example, more than two-layer).
[0094] As glass material, silicic-acid glass (quartz glass), silicic-acid alkali glass, soda lime glass, potash lime glass, lead (alkali) glass, barium glass, borosilicate glass, etc. are mentioned, for example. Among these, compared with silicic-acid glass, the melting point is low, and shaping and processing are also comparatively easy the melting point, and, moreover, things other than silicic-acid glass have it, and are desirable. [cheap]
[0095] When using what consisted of synthetic resin as an imprint object 180, while being able to fabricate the large-scale imprint object 180 in one, even if it is complicated configurations, such as what has a curve side and irregularity, it can manufacture easily, and the various advantages that ingredient cost and a manufacturing cost are also cheap can be enjoyed. Therefore, use of synthetic resin is advantageous when manufacturing a large-sized and cheap device (for example, liquid crystal display).
[0096] In addition, the imprint object 180 may constitute some devices like what constitutes the device which became independent in itself like a liquid crystal cell, a color filter and an electrode layer, a dielectric layer, an insulating layer, and a semiconductor device.
[0097] Furthermore, the imprint objects 180 may be matter, such as a metal, ceramics, a stone, and wood paper, and may be on the front face of the structures, such as a wall, a column, head lining, and a windowpane, further on the field of the arbitration which constitutes a certain article (superiors of the front-face top of the field top of a clock, and an air-conditioner, and a printed circuit board).
[0098] As shown in [a process 4], next drawing 4 , light is irradiated from the rear-face side of a substrate 100.
[0099] After this light penetrates a substrate 100, it is irradiated by the detached core 120. Thereby, the exfoliation in a layer and/or interfacial peeling arise in a detached core 120, and bonding strength is decreased or extinguished.
[0100] It is presumed that it is what is depended on phase changes, such as that ablation produces the principle which the exfoliation in a layer and/or interfacial peeling of a detached core 120 produce in the component of a detached core 120 and emission of the gas contained in the detached core 120, melting further produced immediately after an exposure, and evapotranspiration.
[0101] The fixed ingredient (component of a detached core 120) which absorbed exposure light is excited photochemistry-wise or thermally, ablation means association of the atom of the front face and interior or a molecule being cut, and emitting here, and it mainly appears as a phenomenon in which all or a part of component of a detached core 120 produces phase changes, such as melting and evapotranspiration (evaporation). Moreover, by said phase change, it may be in a minute firing condition and bonding strength may decline.
[0102] Conditions, such as a presentation of a detached core 120, and a class of light irradiated as one of the factor of the, wavelength, reinforcement, the attainment depth, are mentioned by in addition to this being influenced by various factors they are [whether a detached core 120 produces the exfoliation in a layer interfacial peeling is produced, or] the both.
[0103] Here, with the gestalt of this operation, after formation of a detached core 120, in order to make detached core 120 the very thing produce an exfoliation phenomenon more certainly at this 4th process, the ion for exfoliation promotion is poured in.
[0104] This ion for exfoliation promotion promotes three either of the followings, or the exfoliation phenomenon of the detached core [in / for an operation of two or more combination / nothing and the 4th process] 120 at least.
[0105] The ion for exfoliation promotion, for example, the hydrogen, (H) or nitrogen (N) with which one of them was poured into the detached core 120 by operation of this 4th process is

gasificated, and, thereby, exfoliation of a detached core 120 is promoted.
[0106] Other one was set like ion grouting for exfoliation promotion, it cut association of the atom or molecule which constitutes a detached core 120 with the ion for exfoliation promotion, for example, hydrogen, (H), nitrogen (N), or silicon (Si), and has given the damage beforehand to the detached core 120. Therefore, in the detached core 120 to which the damage was given beforehand, exfoliation arises comparatively easily by operation of the 4th process.
[0107] One of further others is set like ion grouting for exfoliation promotion, it changes the property of a detached core 120 with the ion for exfoliation promotion, for example, hydrogen, (H), nitrogen (N), or silicon (Si), and the adhesion of a detached core 120 and a substrate 100 has weakened it beforehand. Also in this case, in the detached core 120 which the adhesion with a substrate was able to weaken, exfoliation arises comparatively easily by operation of the 4th process.
[0108] As a light irradiated at the 4th process, if a detached core 120 is made to start the exfoliation in a layer, and/or interfacial peeling, what kind of thing may be used, for example, an X-ray, ultraviolet rays, the light, infrared radiation (heat ray), a laser beam, a millimeter wave, microwave, an electron ray, a radiation (alpha rays, beta rays, gamma ray), etc. will be mentioned. A laser beam is desirable at the point of being easy to produce exfoliation (ablation) of a detached core 120 also in it.
[0109] As laser equipment made to generate this laser beam, although various gas laser, solid state laser (semiconductor laser), etc. are mentioned, excimer laser, Nd-YAG laser, Ar laser, a CO2 laser, a CO laser, helium-Ne laser, etc. are used suitably, and especially excimer laser is desirable also in it.
[0110] Since it outputs high energy in a short wavelength region, extremely, excimer laser can make a detached core 120 produce ablation for a short time, and it can exfoliate a detached core 120, without making the imprint object 180 and substrate 100 grade which therefore adjoin produce most temperature rises (i.e., without it producing degradation and damage).
[0111] Moreover, when it makes it faced that a detached core 120 produces ablation and there is a wavelength dependency of light, as for the wavelength of the laser beam irradiated, it is desirable that it is 100nm - about 350nm.
[0112] An example of permeability to the wavelength of light of a substrate 100 is shown in drawing 7 . It has the property that permeability increases steeply to the wavelength of 200nm so that it may be illustrated. In such a case, light (wavelength of 308nm) with a wavelength of 210nm or more, for example, Xe-Cl excimer laser light, KrF laser light (wavelength of 248nm), etc. are irradiated.
[0113] Moreover, when making a detached core 120 cause phase changes, such as a gas evolution, evaporation, and sublimation, and giving a separation property to it, as for the wavelength of the laser beam irradiated, it is desirable that it is about 350 to 1200nm.
[0114] Moreover, as for especially the energy density in the case of excimer laser, it is desirable the energy density of the laser beam irradiated and to consider as about two 10 - 5000 mJ/cm, and it is more desirable to consider as about two 100 - 500 mJ/cm. Moreover, as for irradiation time, it is desirable to be referred to as about 1 - 1000ns, and it is more desirable to be referred to as about 10 - 100ns. When sufficient ablation etc. does not arise, and an energy density is high, when an energy density is low or irradiation time is short, or irradiation time is long, there is a possibility of having a bad influence on the transferred layer 140 by the exposure light which penetrated the detached core 120.
[0115] In addition, as a cure in case the exposure light which penetrated the detached core 120 reaches even the transferred layer 140 and does a bad influence, as shown in drawing 30 , there is the approach of forming the metal membranes 124, such as a tantalum (Ta), on a detached core (laser absorption layer) 120, for example. Thereby, it is completely reflected by the interface of a metal membrane 124, and the laser light which penetrated the detached core 120 does not have a bad influence on the thin film device above it.
[0116] Next, the force is applied to a substrate 100 and this substrate 100 is made to secede from a detached core 120, as shown in drawing 5 . Although not illustrated in drawing 5 , a detached core may adhere on a substrate 100 after this balking.

[0117] Next, as shown in drawing 6 , the extant detached core 120 is removed by the approach which combined approaches, such as washing, etching, ashing, and polish, or these. It means that the transferred layer (thin film device layer) 140 had been imprinted by the imprint object 180 by this.
[0118] In addition, when a part of detached core has adhered also to the substrate 100 from which it seceded, it removes similarly. In addition, when the substrate 100 consists of an expensive ingredient like quartz glass, and a rare ingredient, reuse (recycle) is preferably presented with a substrate 100. That is, this invention can be applied to the substrate 100 to reuse, and usefulness is high.
[0119] The imprint to the imprint object 180 of the transferred layer (thin film device layer) 140 is completed through each above process. Then, conductive layers, such as removal of SiO2 film which adjoins the transferred layer (thin film device layer) 140, and wiring of a up to [the transferred layer 140], formation of a desired protective coat, etc. can also be performed.
[0120] Thus, transferred layer (thin film device layer) 140 the very thing which is an exfoliated object is not exfoliated directly. Since it exfoliates in the detached core joined to the transferred layer (thin film device layer) 140, Irrespective of the property of an exfoliated object (transferred layer 140), conditions, etc., easily and certainly, it can exfoliate in homogeneity (imprint), there is also no damage to the exfoliated object (transferred layer 140) in accordance with exfoliation actuation, and the high dependability of the transferred layer 140 can be maintained.
[0121] Next, TFT of for example, CMOS structure is formed as a thin film device layer 140 on a substrate 100 and a detached core 120, and the example of the concrete manufacture process in the case of imprinting this on an imprint object is explained using drawing 8 - drawing 18 . In addition, even if it attaches like ion grouting for exfoliation promotion carried out in the middle of this process, it explains.
[0122] (Process 1) as shown in drawing 8 , on the translucency substrate (for example, quartz substrate) 100, laminating formation of a detached core (for example, LPCVD amorphous silicon layer formed of law) 120, an interlayer (for example, SiO2 film) 142, and the amorphous silicon layer (for example, LPCVD — formed of law) 143 is carried out one by one, then laser light is irradiated from the upper part all over the amorphous silicon layer 143, and annealing is given. Thereby, the amorphous silicon layer 143 is recrystallized and turns into a polish recon layer. In addition, when carrying out laser annealing in this case with a beam scan, it is desirable in the same part that an optical exposure is carried out 2 times or more so that the beam cores of the beam of each time may lap unlike the beam scan to the above-mentioned detached core 120 (it removes in the case of a Gaussian beam). In this case, it is because there are no evils, such as optical leakage, and the amorphous silicon layer 143 can fully be recrystallized by carrying out a multiplex exposure.
[0123] If it is after formation of a detached core 120 and is before the laser annealing process for crystallization as an operation stage of the impregnation process of the ion for exfoliation promotion, it is desirable at the point that an ion implantation can be carried out without needing a mask.
[0124] Therefore, as the operation stage, it is after formation of the detached core 120 of (A) drawing 8 , is after formation of an interlayer's 142 (B) interlayer 142 before formation, is after formation of the amorphous silicon layer 143 (before [C]) formation of the amorphous silicon layer 143, and becomes either in front of the laser annealing process for the crystallization. This (A) In - (C), the operation stage of (C) is the most desirable. In the reason, the formation process of the amorphous silicon layer 143, i.e., the formation process of a channel layer, serves as process temperature of about 425 degrees C in the present condition. When the hydrogen ion is already poured into the detached core 120 as in this case, for example, ion for exfoliation promotion, there is a possibility that hydrogen may escape from and come out of a detached core 120 at the temperature of 350 degrees C or more. Therefore, as for the impregnation process of the ion for exfoliation promotion, it is desirable to carry out with the operation stage after the channel stratification (C). However, since there is such no limit depending on the class of ion for exfoliation promotion, an operation stage (A) and (B) can also be carried out. Moreover, it is desirable on transistor characteristics that the damage resulting from impregnation of the

ion for exfoliation promotion has not arisen in the layer after laser annealing of the amorphous silicon layer 143 was carried out and it was polycrystal-ized. In being (C), even if there is no generating of a damage itself in (A) and (B), and a damage arises in amorphous silicon layer 143 the very thing, the effect of the damage will be reduced according to a subsequent crystallization process.

[0125] In addition, like this ion grouting for exfoliation promotion, it can carry out using well-known ion implantation equipment. That is, if a hydrogen ion is poured in, for example, the gas containing hydrogen is plasma-ized and the hydrogen ion generated by it can be poured into a detached core 120 by accelerating by electric field.

[0126] As an operation stage like ion grouting (D), you may be after laser annealing. In this case, transistor characteristics will not be degraded, if the mask of the part used as a channel field is carried out and it carries out an ion implantation. In addition, as for a mask, ion grouting is removed behind. As it is alike (process 2), then is shown in drawing 9 , patterning of the polish recon layer obtained by laser annealing is carried out, and Islands 144a and 144b are formed as a channel pattern.

[0127] Like ion grouting for exfoliation promotion, it can carry out after the 2nd process (channel pattern formation process) as the operation stage (E) besides (A) - (D) mentioned above. In this case, as shown in drawing 31 , it is on island 144a and 144b, and the mask pattern 201 is formed in the channel field in island 144a and 144b, and the part which counters. And the ion for exfoliation promotion, for example, a hydrogen ion, is turned and poured into a detached core 120 in the condition. Thereby, hydrogen does not contain to a channel field and transistor characteristics do not deteriorate. In addition, if it ends like ion grouting for exfoliation promotion, a mask pattern 201 will be removed.

[0128] (Process 3) As shown in drawing 10 , wrap gate dielectric film 148a and 148b is formed for Islands 144a and 144b with a CVD method.

[0129] Like ion grouting for exfoliation promotion, it can carry out after the 3rd process (gate dielectric film) as the operation stage (F) besides (A) - (E) mentioned above. In this case, as shown in drawing 32 , it is on gate-dielectric-film 148a and 148b, and it is desirable to form a mask pattern 202 in the channel field in island 144a and 144b and the part which counters.

[0130] (Process 4) As shown in drawing 11 , the gate electrodes 150a and 150b which consist of polish recon or metal are formed.

[0131] (Process 5) As shown in drawing 12 , the mask layer 170 which consists of polyimide etc. is formed, using gate electrode 150b and the mask layer 170 as a mask, it is a self aryne, for example, the ion implantation of boron (B) is performed. Of this, the p+ layers 172a and 172b are formed.

[0132] Like ion grouting for exfoliation promotion, this boron ion grouting simultaneously can be carried out as that operation stage (G) besides (A) - (F) mentioned above. In this case, the mixed gas of B-2H6(5%)+H2 (95%) is plasma-ized, the boron ion and hydrogen ion which were generated by that cause are accelerated, and it leads to a substrate, without minding a mass spectrograph. If it does so, even if it is the same acceleration voltage, while the boron ion with heavy mass stops at the polycrystalline silicon layer by the side of the upper layer, the hydrogen ion with light mass will be driven in more deeply, and it will reach to a detached core 120.

[0133] In addition, although gate electrode 150b functions as the mask pattern 201 of drawing 31 , or the mask pattern 202 of drawing 32 similarly at this time, according to acceleration voltage, a mask layer can be further prepared on gate electrode 150b.

[0134] (Process 6) As shown in drawing 13 , the mask layer 174 which consists of polyimide etc. is formed, using gate electrode 150a and the mask layer 174 as a mask, it is a self aryne, for example, the ion implantation of Lynn (P) is performed. Of this, the n+ layers 146a and 146b are formed.

[0135] Like ion grouting for exfoliation promotion, this phosphorus ion grouting simultaneously can be carried out as that operation stage (H) besides (A) - (G) mentioned above. Also in this case, the mixed gas of PH3(5%)+H2 (95%) is plasma-ized, the phosphorus ion and hydrogen ion which were generated by that cause are accelerated, and it leads to a substrate, without minding a mass spectrograph. If it does so, even if it is the same acceleration voltage, while the

phosphorus ion with heavy mass stops at the polycrystalline silicon layer by the side of the upper layer, the hydrogen ion with light mass will be driven in more deeply, and it will reach to a detached core 120.
[0136] In addition, although gate electrode 150a functions as the mask pattern 201 of drawing 31 , or the mask pattern 202 of drawing 32 similarly in this case, according to acceleration voltage, a mask layer can be further prepared on gate electrode 150a.
[0137] Moreover, although the operation stage like the above-mentioned ion grouting for exfoliation promotion (G) and (H) were as simultaneous as impurity ion grouting to the source in a process 5 and a process 6, and a drain field, they may be separately performed before and behind that.
[0138] (Process 7) As shown in drawing 14 , an interlayer insulation film 154 is formed and Electrodes 152a-152d are alternatively formed after contact hole formation.
[0139] Thus, TFT of the formed CMOS structure corresponds to the transferred layer (thin film device layer) 140 in drawing 2 - drawing 6 . In addition, a protective coat may be formed on an interlayer insulation film 154.
[0140] (Process 8) As shown in drawing 15 , the epoxy resin layer 160 as a glue line is formed on TFT of a CMOS configuration, next TFT is stuck on the imprint object (for example, soda glass substrate) 180 through the epoxy resin layer 160. Then, heat is applied, an epoxy resin is stiffened and the imprint object 180 and TFT are pasted up (junction).
[0141] In addition, the photopolymer resin which is ultraviolet curing mold adhesives is sufficient as a glue line 160. In this case, ultraviolet rays are irradiated from the imprint object [not heat but] 180 side, and a polymer is stiffened.
[0142] (Process 9) As shown in drawing 16 , Xe-Cl excimer laser light is irradiated from the rear face of the translucency substrate 100, for example. This produces and cheats out of exfoliation in the inside of the layer of a detached core 120, and/or an interface.
[0143] (Process 10) A substrate 100 is torn off as shown in drawing 17 .
[0144] (Process 11) Finally etching removes a detached core 120. It means that TFT of a CMOS configuration had been imprinted by the imprint object 180 by this as shown in drawing 18 .
[0145] <The gestalt of the 2nd operation>, next the gestalt of operation of the 2nd of this invention are explained with reference to drawing 33 - drawing 35 . In addition, the gestalt of this 2nd operation imprints twice the transferred layer 140 which consists of thin film device layers, and, in addition to the process of drawing 1 of the gestalt of the 1st operation - drawing 6 , the process of drawing 33 - drawing 35 is added.
[0146] Here, with the gestalt of this 2nd operation, the detached core 120 shown in drawing 2 - drawing 5 is called the 1st detached core. Moreover, with the gestalt of this 2nd operation, the glue line 160 of drawing 3 - drawing 6 is called the 2nd detached core. Furthermore, with the gestalt of this 2nd operation, the imprint object 180 of drawing 3 - drawing 6 is called a primary imprint object. Therefore, according to the gestalt of this 2nd operation, in the phase which the process of drawing 6 ended, it means that the transferred layer 140 had been imprinted by the primary imprint object 180 through the 2nd detached core 160.
[0147] With the gestalt of the 2nd operation here, the quality of the material of the 2nd detached core 160 can use the thing of the same quality of the material not only as thermofusion nature adhesives and water-soluble adhesives but the 1st detached core 120. In order to make easy exfoliation by this 2nd detached core 160 at this time, the ion implantation which was mentioned above and which was explained with the gestalt of the 1st operation can be performed.
[0148] More nearly hereafter, the additional processing of drawing 33 carried out after the process of drawing 6 - drawing 35 explains 1-3.
[0149] As [additional processing is shown in drawing 33 following the process of 1] drawing 6 , the secondary imprint layer 200 is pasted up on the inferior surface of tongue (exposure) of the thin film device layer 140 through a glue line 190.
[0150] As a suitable example of the adhesives which constitute a glue line 190, various hardening mold adhesives, such as photo-curing mold adhesives, such as reaction hardening mold adhesives, heat-curing mold adhesives, and ultraviolet curing mold adhesives, and aversion hardening mold adhesives, are mentioned. As a presentation of adhesives, what kind of thing is

sufficient as an epoxy system, an acrylate system, a silicone system, etc., for example. Formation of such a glue line 190 is made for example, by the applying method.
[0151] After applying hardening mold adhesives to the inferior surface of tongue of the transferred layer (thin film device layer) 140 and joining the secondary imprint object 200 further when using said hardening mold adhesives for example, said hardening mold adhesives are stiffened by the hardening approach according to the property of hardening mold adhesives, and the transferred layer (thin film device layer) 140 and the secondary imprint object 200 are pasted up, and it fixes.
[0152] When adhesives are photo-curing molds, light is preferably irradiated from the outside of the secondary imprint object 200 of light transmission nature. As long as it uses as adhesives photo-curing mold adhesives, such as an ultraviolet curing mold which cannot affect a thin film device layer easily, an optical exposure may be carried out from the primary imprint object 180 side of light transmission nature, or primary [of light transmission nature] and the both sides of the secondary imprint object 180,200.
[0153] In addition, unlike illustration, a glue line 190 may be formed in the secondary imprint object 200 side, and the transferred layer (thin film device layer) 140 may be pasted up on it. In addition, when secondary imprint object 200 the very thing has an adhesion function, for example, formation of a glue line 190 may be omitted.
[0154] although not limited especially as a secondary imprint object 200 — a substrate (plate) — especially a transparence substrate is mentioned. In addition, such a substrate may be monotonous or may be a curve plate.
[0155] Moreover, compared with said substrate 100, properties, such as thermal resistance and corrosion resistance, may be inferior in the secondary imprint object 200. It is because the reason forms the transferred layer (thin film device layer) 140 in a substrate 100 side in this invention, and imprints the transferred layer (thin film device layer) 140 on the secondary imprint object 200 after that, so it does not depend on the temperature conditions in the case of formation of the transferred layer (thin film device layer) 140 etc. for the property required of the secondary imprint object 200, especially thermal resistance. This point is the same also about the primary imprint object 180.
[0156] Therefore, when the maximum temperature in the case of formation of the transferred layer 140 is set to Tmax, a glass transition point (Tg) or softening temperature can use the following [Tmax] as a component of primary and the secondary imprint object 180,200. For example, a glass transition point (Tg) or softening temperature can constitute more preferably primary and 800 degrees C or less of 500 degrees C or less of secondary imprint objects 180,200 from an ingredient 320 degrees C or less still more preferably.
[0157] Moreover, although what has a certain amount of ** (reinforcement) as a mechanical property of primary and the secondary imprint object 180,200 is desirable, you may have flexibility and elasticity.
[0158] As a component of such primary and the secondary imprint object 180,200, various synthetic resin or various glass material are mentioned, and various synthetic resin and the usual cheap glass material (low melting point) are desirable especially.
[0159] As synthetic resin, any of thermoplastics and thermosetting resin are sufficient. For example, polyethylene, a polo propylene, an ethylene-pre pyrene copolymer, Polyolefines, such as an ethylene-vinylacetate copolymer (EVA), annular polyolefine, Denaturation polyolefine, a polyvinyl chloride, a polyvinylidene chloride, polystyrene, A polyamide, polyimide, polyamidoimide, a polycarbonate, Polly (4-methyl BENTEN -1), An ionomer, acrylic resin, polymethylmethacrylate, an acrylic-styrene copolymer (AS resin), Butadiene Styrene, a polio copolymer (EVOH), polyethylene terephthalate (PET), Polyester, such as polyp CHIREN terephthalate (PBT) and PURISHI clo hexane terephthalate (PCT), A polyether, a polyether ketone (PEK), a polyether ether ketone (PEEK), Polyether imide, polyacetal (POM), polyphenylene oxide, Denaturation polyphenylene oxide, polyarylate, aromatic polyester (liquid crystal polymer), Polytetrafluoroethylene, polyvinylidene fluoride, other fluorine system resin, A styrene system, a polyolefine system, a polyvinyl chloride system, a polyurethane system, Various thermoplastic elastomer, such as a fluororubber system and a chlorinated polyethylene system, EBOKISHI

resin, phenol resin, a urea resin, melamine resin, unsaturated polyester, The copolymer which is mainly concerned with these, a blend object, a polymer alloy, etc. are mentioned, and silicone resin, polyurethane, etc. can be used combining 1 of sorts of these, and two sorts or more (as a layered product for example, more than two-layer).
[0160] As glass material, silicic-acid glass (quartz glass), silicic-acid alkali glass, soda lime glass, potash lime glass, lead (alkali) glass, barium glass, borosilicate glass, etc. are mentioned, for example. Among these, compared with silicic-acid glass, the melting point is low, and shaping and processing are also comparatively easy the melting point, and, moreover, things other than silicic-acid glass have it, and are desirable. [cheap]
[0161] When using what consisted of synthetic resin as a secondary imprint object 200, while being able to fabricate the large-scale secondary imprint object 200 in one, even if it is complicated configurations, such as what has a curve side and irregularity, it can manufacture easily, and the various advantages that ingredient cost and a manufacturing cost are also cheap can be enjoyed. Therefore, use of synthetic resin is advantageous when manufacturing a large-sized and cheap device (for example, liquid crystal display).
[0162] In addition, the secondary imprint object 200 may constitute some devices like what constitutes the device which became independent in itself like a liquid crystal cell, a color filter and an electrode layer, a dielectric layer, an insulating layer, and a semiconductor device.
[0163] Furthermore, primary and the secondary imprint objects 180,200 may be matter, such as a metal, ceramics, a stone, and wood paper, and may be on the front face of the structures, such as a wall, a column, head lining, and a windowpane, further on the field of the arbitration which constitutes a certain article (superiors of the front-face top of the field top of a clock, and an air-conditioner, and a printed circuit board).
[0164] As [additional processing is shown in 2], next drawing 34 , thermofusion of the thermofusion nature glue line 160 which is the 2nd detached core is heated and carried out. Consequently, since the adhesive strength of the thermofusion nature glue line 160 becomes weaker, it can be made to secede from the primary imprint object 180 by the thin film device layer 140. In addition, this primary imprint object 180 can be repeated and reused by removing the thermofusion nature adhesives adhering to the primary imprint object 180.
[0165] What is necessary is just to dip preferably the field which contains the 2nd detached core 160 at least in pure water that what is necessary is just to make water contact, when the water-soluble adhesives mentioned above as the 2nd detached core 160 are used. What is necessary is just to contact the field which contains the 2nd detached core 160 at least to an organic solvent, when the organic solvent melting nature adhesives mentioned above as the 2nd detached core 160 are used. the field which contains the 2nd detached core 160 at least when the adhesives which present an exfoliation operation by heating or UV irradiation mentioned above as the 2nd detached core 160 are used — other layers — minding — heating — or what is necessary is just to carry out UV irradiation Moreover, when an ablation layer is used like the 1st detached core 120 as the 2nd detached core, the 2nd detached core 160 is made to produce an exfoliation phenomenon by optical exposure. That exfoliation is promoted by the effectiveness of impregnation ion at this time.
[0166] As [additional processing is shown in drawing 35 by removing the 2nd detached core 160 which adhered to the front face of the thin film device layer 140 at the 3] last, the thin film device layer 140 imprinted by the secondary imprint object 200 can be obtained. Here, the laminating relation of the thin film device layer 140 to this secondary imprint object 200 becomes the same as the laminating relation of the thin film device layer 140 to the original substrate 100, as shown in drawing 2 .
[0167] The imprint to the secondary imprint object 200 of the transferred layer (thin film device layer) 140 is completed through each above process. Then, conductive layers, such as removal of SiO_2 film which adjoins the transferred layer (thin film device layer) 140, and wiring of a up to [the transferred layer 140], formation of a desired protective coat, etc. can also be performed.
[0168] With the gestalt of the 2nd operation, transferred layer (thin film device layer) 140 the very thing which is an exfoliated object is not exfoliated directly. In order to dissociate in the 1st detached core 120 and the 2nd detached core 160 and to imprint on the secondary imprint

object 200, Irrespective of the property of a dissociated object (transferred layer 140), conditions, etc., easily and certainly, it can imprint to homogeneity, there is also no damage to the dissociated object (transferred layer 140) in accordance with separation actuation, and the high dependability of the transferred layer 140 can be maintained.
[0169] If the technique explained with the <gestalt of the 3rd operation> above-mentioned 1st and the gestalt of the 2nd operation is used, the microcomputer constituted using the thin film device as shown in drawing 19 (a), for example can be formed on a desired substrate.
[0170] In drawing 19 (a), the solar battery 340 possessing the PIN junction of an amorphous silicon for supplying the supply voltage of CPU300, RAM320 and the I/O circuits 360 where the thin film device was used and the circuit was constituted, and these circuits is carried on the flexible substrate 182 which consists of plastics etc.
[0171] Since the microcomputer of drawing 19 (a) is formed on the flexible substrate, as shown in drawing 19 (b), since it is lightweight, it has strongly the description that it is strong also to fall in bending.
[0172] The gestalt of <gestalt of the 4th operation> book operation explains the example of the manufacture process in the case of creating the liquid crystal display of the active-matrix mold using a active-matrix substrate as shown in drawing 20 and drawing 21 using the imprint technique of an above-mentioned thin film device.
[0173] (Configuration of a liquid crystal display) As shown in drawing 20 , the liquid crystal display of a active-matrix mold possesses the sources 400 of the illumination light, such as a back light, a polarizing plate 420, the active-matrix substrate 440, liquid crystal 460, the opposite substrate 480, and a polarizing plate 500.
[0174] In addition, if it constitutes as a reflective mold liquid crystal panel which replaced with the source 400 of the illumination light, and adopted the reflecting plate when using a flexible substrate like plastic film for the active-matrix substrate 440 and the opposite substrate 480 of this invention, there is flexibility and a lightweight active matrix liquid crystal panel strong against an impact and can be realized. In addition, when a pixel electrode is formed with a metal, a reflecting plate and a polarizing plate 420 become unnecessary.
[0175] The active-matrix substrate 440 used with the gestalt of this operation arranges TFT in the pixel section 442, and is a driver built-in active-matrix substrate in which the driver circuit (a scanning-line driver and data-line driver) 444 was carried further.
[0176] The sectional view of the important section of this active matrix liquid crystal display is shown in drawing 21 , and the circuitry of the important section of a liquid crystal display is shown in drawing 22 .
[0177] As shown in drawing 22 , the gate is connected to the gate line G1, one side of a source drain is connected to the data line D1, and the pixel section 442 contains TFT (M1) by which another side of a source drain was connected to liquid crystal 460, and liquid crystal 460.
[0178] Moreover, the driver section 444 is constituted including TFT (M2) formed of the same process as TFT (M1) of the pixel section.
[0179] As shown in the left-hand side of drawing 21 , TFT (M1) in the pixel section 442 is constituted including the source drain layers 1100a and 1100b, channel 1100e, gate-dielectric-film 1200a, gate electrode 1300a, an insulator layer 1500, and the source drain electrodes 1400a and 1400b.
[0180] In addition, a reference number 1700 is a pixel electrode and a reference number 1702 shows the field (electrical-potential-difference impression field to liquid crystal) where the pixel electrode 1700 impresses an electrical potential difference to liquid crystal 460. The orientation film is omitted among drawing. The pixel electrode 1700 is constituted by metals (in the case of the liquid crystal panel of a reflective mold), such as ITO (in the case of the liquid crystal panel of a light transmission mold), or aluminum. Moreover, in drawing 21 , in the electrical-potential-difference impression field 1702 to liquid crystal, although the substrate insulator layer 1000 under the pixel electrode 1700 (interlayer) is removed completely, it is not necessarily limited to this, and since the substrate insulator layer (interlayer) 1000 is thin, when not becoming the hindrance of the electrical-potential-difference impression to liquid crystal, you may leave.
[0181] Moreover, as shown in the right-hand side of drawing 21 , TFT (M2) which constitutes the

driver section 444 is constituted including the source, the drain layers 1100c and 1100d, channel 1100f, gate-dielectric-film 1200b, gate electrode 1300b, an insulator layer 1500, and the source drain electrodes 1400c and 1400d.
[0182] In addition, in drawing 21 , a reference number 480 is for example, an opposite substrate (for example, soda glass substrate), and a reference number 482 is a common electrode. Moreover, a reference number 1000 is SiO2 film, a reference number 1600 is an interlayer insulation film (for example, SiO2 film), and a reference number 1800 is a glue line. Moreover, a reference number 1900 is a substrate (imprint object) which consists for example, of a soda glass substrate.
[0183] (Manufacture process of a liquid crystal display) The manufacture process of the liquid crystal display of drawing 21 is hereafter explained with reference to drawing 23 - drawing 27 .
[0184] First, it forms through the same manufacture process as drawing 8 - drawing 18 on the substrate (for example, quartz substrate) 3000 which it is reliable in TFT (M1, M2) like drawing 23 , and penetrates laser light, and a protective coat 1600 is constituted. In addition, in drawing 23 , a reference number 3100 is a detached core (laser absorption layer) into which the ion for exfoliation promotion is poured. Moreover, in drawing 23 , both TFT(s) (M1, M2) are taken as MOSFET of n mold. However, it is good also as not the thing limited to this but MOSFET of p mold, and CMOS structure.
[0185] Next, as shown in drawing 24 , a protective coat 1600 and the substrate insulator layer 1000 are etched alternatively, and openings 4000 and 4200 are formed alternatively. These two openings are formed in coincidence using a common etching process. In addition, although the substrate insulator layer (interlayer) 1000 is completely removed in opening 4200 in drawing 24 , it is not necessarily limited to this, and since the substrate insulator layer (interlayer) 1000 is thin, when not becoming the hindrance of the electrical-potential-difference impression to liquid crystal, you may leave.
[0186] Next, as shown in drawing 25 , the pixel electrode 1700 which consists of metals, such as ITO film or aluminum, is formed. In using the ITO film, it becomes the liquid crystal panel of a transparency mold, and in using metals, such as aluminum, it becomes the liquid crystal panel of a reflective mold. Next, as shown in drawing 26 , a substrate 1900 is joined through a glue line 1800 (adhesion).
[0187] Next, excimer laser light is irradiated from the rear face of a substrate 3000, the operation by the ion for exfoliation promotion is also used, and a detached core 120 is made to produce an exfoliation phenomenon, as shown in drawing 26 . Then, a substrate 3000 is torn off. Since the force like ** is not required for tearing off at this time, a mechanical damage does not arise in TFT.
[0188] Next, a detached core (laser absorption layer) 3100 is removed. Thereby, the active-matrix substrate 440 as shown in drawing 27 is completed. It has exposed and the electric connection with liquid crystal is possible for the base (field of a reference number 1702) of the pixel electrode 1700. Then, the orientation film is formed in the front face of the insulator layer (interlayers, such as SiO2) 1000 of the active-matrix substrate 440, and pixel electrode 1702 front face, and orientation processing is performed. The orientation film is omitted in drawing 27 .

[0189] And the pixel electrode 1709 and the common electrode which counters are further formed in the front face, the opposite substrate 480 and the active MATORIKU substrate 440 of drawing 21 with which orientation processing of the front face was carried out are closed with a sealing agent (sealant), liquid crystal is enclosed among both substrates, and a liquid crystal display as shown in drawing 21 is completed.
[0190] The gestalt of operation of the 5th of this invention is shown in <gestalt of the 5th operation> drawing 28 .
[0191] With the gestalt of this operation, multiple-times activation of the imprint approach of an above-mentioned thin film device is carried out, on a larger substrate (imprint object) than the substrate of an imprinting agency, two or more patterns containing a thin film device are imprinted, and, finally a large-scale active-matrix substrate is formed.
[0192] That is, on the big substrate 7000, the imprint of multiple times is performed and the pixel

sections 7100a-7100P are formed. TFT and wiring are formed in the pixel section as surrounded and shown to the drawing 28 bottom by the alternate long and short dash line. In drawing 28 , a reference number 7210 is the scanning line, a reference number 7200 is a signal line and a reference number 7230 is [a reference number 7220 is a gate electrode and] a pixel electrode.
[0193] The large-scale active-matrix substrate carrying a reliable thin film device can be created by repeating and using a reliable substrate or carrying out multiple-times activation of the imprint of a thin film pattern using two or more 1st substrates.
[0194] The gestalt of operation of the 6th of <gestalt of the 6th operation> this invention is shown in drawing 29 .
[0195] The description of the gestalt of this operation is imprinting two or more patterns containing the thin film device (that is, thin film device with which minimum line width's differs) with which multiple-times activation of the imprint approach of an above-mentioned thin film device is carried out, and the design Ruhr's (that is, design rule's when carrying out a pattern design's) differs on a bigger substrate than the substrate top of an imprinting agency.
[0196] In drawing 29 , the driver circuit (8000-8032) created in the more detailed manufacture process rather than the pixel section (7100a-7100p) is created around the substrate 6000 by the imprint of multiple times in the active-matrix substrate of driver loading.
[0197] Since the shift register which constitutes a driver circuit carries out actuation of a logic level to the bottom of a low battery, rather than Pixel TFT, pressure-proofing may be low, and as it is therefore set to TFT more detailed than Pixel TFT, high integration can be attained.
[0198] According to the gestalt of this operation, two or more circuits where design Ruhr level differs (that is, manufacture processes differ) are realizable on one substrate. In addition, since high pressure-proofing is the need like Pixel TFT, a sampling means (thin film transistor M2 of drawing 22) to sample a data signal by control of a shift register may be formed in the same process as Pixel TFT / same design Ruhr.
[0199]
[Example] Next, the concrete example of this invention is explained.
[0200] (Example 1) The quartz substrate (1630 degrees C, a strain point: softening temperature : 1070 degrees C, permeability of excimer laser : about 100%) with a 50mm[50mm by] x thickness of 1.1mm was prepared, and the amorphous silicon (a-Si) film was formed in one side of this quartz substrate as a detached core (laser beam absorption layer) with the low voltage CVD method (Si2 H6 gas, 425 degrees C). The thickness of a detached core was 100nm.
[0201] Next, it is SiO2 as an interlayer on a detached core. The film was formed with the ECR-CVD method (SiH4+O2 gas, 100 degrees C). An interlayer's thickness was 200nm.
[0202] Next, the amorphous silicon film of 50nm of thickness was formed as a transferred layer on the interlayer with the low voltage CVD method (Si2 H6 gas, 425 degrees C), a laser beam (wavelength of 308nm) is irradiated, this amorphous silicon film was crystallized, and it considered as the polish recon film. Then, to this polish recon film, predetermined pattern NINGU was given and the field used as the source drain channel of a thin film transistor was formed. then, a TEOS-CVD method (SiH4+O2 gas) — 1200nm gate dielectric film SiO2 after forming, form a gate electrode (structure where laminating formation of the refractory metals, such as Mo, was carried out at polish recon), on gate dielectric film, and it carries out an ion implantation, using a gate electrode as a mask — self align ---like (selfer line) — the source drain field was formed and the thin film transistor was formed. At this time, the hydrogen ion was poured into coincidence at the detached core. Then, the electrode connected to a source drain field and wiring, and wiring which leads to a gate electrode are formed if needed. Although aluminum is used for these electrodes and wiring, it is not limited to this. Moreover, when worrying about melting of aluminum by the laser radiation of a back process, a high-melting metal (what is not fused by the laser radiation of a back process) may be used rather than aluminum.
[0203] Next, ultraviolet curing mold adhesives were applied on said thin film transistor (thickness: 100 micrometers), further, after joining a transparent large-sized glass substrate (soda glass, softening-temperature:740 degree C, a strain point: 511 degrees C) with a 300mm[200mm by] x thickness of 1.1mm to the paint film as an imprint object, ultraviolet rays were irradiated from the glass substrate side, adhesives were stiffened, and adhesion immobilization of these was

carried out.
[0204] Next, Xe-Cl excimer laser (wavelength: 308nm) was irradiated from the quartz substrate side, and the detached core was made to produce exfoliation (exfoliation in a layer, and interfacial peeling) by carrying out the beam scan shown after drawing 31 . The irradiated energy density of Xe-Cl excimer laser was 250 mJ/cm2, and irradiation time was 20ns. In addition, the exposure of excimer laser had a spot beam exposure and the Rhine beam exposure, and when it was a spot beam exposure, the spot exposure was carried out to the predetermined unit field (for example, 8mmx8mm), and it irradiated this spot exposure, carrying out a beam scan so that the exposure field of each time may not lap (it does not lap all around like). Moreover, in the Rhine beam exposure, it irradiated, carrying out the beam scan of the predetermined unit field (for example, 378mmx0.1mm and 378mmx0.3mm (field where, as for these, 90% or more of energy is obtained)) similarly, so that the exposure field of each time may not lap.
[0205] Then, the quartz substrate and the glass substrate (imprint object) were torn off in the detached core, and the thin film transistor and interlayer who were formed on the quartz substrate were imprinted to the glass substrate side.
[0206] Then, etching, washing, or those combination removed the detached core adhering to the front face of the middle class by the side of a glass substrate. Moreover, processing with the same said of a quartz substrate was performed, and the reuse was presented.
[0207] In addition, if the glass substrate used as an imprint object is a bigger substrate than a quartz substrate, the imprint to a glass substrate from a quartz substrate like this example can be repeatedly carried out to a superficially different field, and many thin film transistors can be formed on a glass substrate from the number of the thin film transistors which can be formed in a quartz substrate. Furthermore, on a glass substrate, a laminating can be carried out repeatedly and more thin film transistors can be formed similarly.
[0208] (Example 2) a detached core — a detached core formation process — H (hydrogen) — 20at(s)% — the thin film transistor was imprinted like the example 1 except having considered as the amorphous silicon film to contain.
[0209] In addition, adjustment of the amount of H in the amorphous silicon film was performed by setting up suitably the conditions at the time of membrane formation by the low voltage CVD method.
[0210] (Example 3) The thin film transistor was imprinted like the example 1 except having used the detached core as the ceramic thin film (presentation-bTiO3, thickness: 200nm) formed with the sol-gel method with the spin coat.
[0211] (Example 4) The thin film transistor was imprinted like the example 1 except having used the detached core as the ceramic thin film (presentation: BaTiO3, thickness:400nm) formed by sputtering.
[0212] (Example 5) The thin film transistor was imprinted like the example 1 except having used the detached core as the ceramic thin film (presentation :P b (Zr Ti)O3 (PZT) and thickness: 50nm) formed by the laser-ablation method.
[0213] (Example 6) The thin film transistor was imprinted like the example 1 except having used the detached core as the polyimide film (thickness: 200nm) formed with the spin coat.
[0214] (Example 7) The thin film transistor was imprinted like the example 1 except having used the detached core as the polyphenylene sulfide film (thickness: 200nm) formed with the spin coat.
[0215] (Example 8) The thin film transistor was imprinted like the example 1 except having used the detached core as aluminum layer (thickness: 300nm) formed by sputtering.
[0216] (Example 9) As an exposure light, the thin film transistor was imprinted like the example 2 except having used Kr-F excimer laser (wavelength: 248nm). In addition, the energy density of the irradiated laser was 250 mJ/cm2, and irradiation time was 20ns.
[0217] (Example 10) As an exposure light, the thin film transistor was imprinted like the example 2 except having used Nd-YAIG laser (wavelength: 1068nm). In addition, the energy density of the irradiated laser was 400 mJ/cm2, and irradiation time was 20ns.
[0218] (Example 11) The thin film transistor was imprinted like the example 1 except having considered as the thin film transistor of the polish recon film (80nm of thickness) by elevated-

temperature process 1000 degree C as a transferred layer.
[0219] (Example 12) As an imprint object, the thin film transistor was imprinted like the example 1 except having used the transparence substrate made from a polycarbonate (glass transition point: 130 degrees C).
[0220] (Example 13) As an imprint object, the thin film transistor was imprinted like the example 2 except having used the transparence substrate made of an AS resin (glass transition point: 70-90 degrees C).
[0221] (Example 14) As an imprint object, the thin film transistor was imprinted like the example 3 except having used the transparence substrate made from polymethylmethacrylate (glass transition point: 70-90 degrees C).
[0222] (Example 15) As an imprint object, the thin film transistor was imprinted like the example 5 except having used the transparence substrate made from polyethylene terephthalate (glass transition point: 67 degrees C).
[0223] (Example 16) As an imprint object, the thin film transistor was imprinted like the example 6 except having used the transparence substrate made from high density polyethylene (glass transition point: 77-90 degrees C).
(Example 17) As an imprint object, the thin film transistor was imprinted like the example 9 except having used the transparence substrate made from a polyamide (glass transition point: 145 degrees C).
[0224] (Example 18) As an imprint object, the thin film transistor was imprinted like the example 10 except having used the transparence substrate made of an epoxy resin (glass transition point: 120 degrees C).
[0225] (Example 19) As an imprint object, the thin film transistor was imprinted like the example 11 except having used the transparence substrate made from polymethylmethacrylate (glass transition point: 70-90 degrees C).
[0226] About examples 1-19, when the condition of the imprinted thin film transistor was guessed the ** view under the naked eye and the microscope, respectively, all had neither a defect nor nonuniformity and the imprint was made by homogeneity.
[0227] As stated above, when using the imprint technique of this invention, it was able to become possible to imprint a thin film device (transferred layer) to various imprint objects, especially exfoliation of a substrate required for an imprint was able to be performed reasonable, without acting too much force. or [that a thin film cannot be formed directly by this] -- or it can be formed by imprint also to what consisted of an ingredient unsuitable for forming, an ingredient with easy shaping, a cheap ingredient, etc., the large-sized body which is hard to move.
[0228] That in which properties, such as thermal resistance and corrosion resistance, are inferior compared with various synthetic resin or a substrate ingredient like glass material with the low melting point can be used especially for an imprint object. therefore -- for example, it can face manufacturing the liquid crystal display in which the thin film transistor (especially poly-Si TFT) was formed on the transparence substrate, and a large-sized and cheap liquid crystal display can be easily manufactured now as an imprint object as a substrate using the quartz-glass substrate which is excellent in thermal resistance by using a transparence substrate of the ingredient which it is cheap and processing tends to carry out like glass material with low various synthetic resin and melting point. Such an advantage is the same also about manufacture of not only a liquid crystal display but other devices.
[0229] Moreover, although the above advantages are enjoyed, since a transferred layer like a functional thin film can be formed to a heat-resistant high substrate like a reliable substrate, especially a quartz-glass substrate and patterning can be carried out further, a reliable functional thin film can be formed on an imprint object irrespective of the material property of an imprint object.
[0230] Moreover, although such a reliable substrate is expensive, it is also possible to reuse it and, therefore, a manufacturing cost is also reduced.
[0231]

[Translation done.]

* NOTICES *

TECHNICAL FIELD

[Field of the Invention] This invention relates to the exfoliation approach of a thin film device, the imprint approach of a thin film device, a thin film device, a active-matrix substrate, and a liquid crystal display.

[Translation done.]

PRIOR ART

[Background of the Invention] For example, it faces manufacturing the liquid crystal display using a thin film transistor (TFT), and passes through the process which forms a thin film transistor by CVD etc. on a substrate. Since the process which forms a thin film transistor on a substrate is accompanied by high temperature processing, a substrate needs to use what has the high thing, i.e., the softening temperature, and the high melting point of the quality of the material which is excellent in thermal resistance. Therefore, in current, quartz glass is used as a substrate which bears the temperature of about 1000 degrees C, and heat-resisting glass is used as a substrate which bears the temperature around 500 degrees C.
[0003] As mentioned above, the substrate carrying a thin film device must satisfy the conditions for manufacturing those thin film devices. That is, it is determined that the substrate to be used will surely fulfill the manufacture conditions of the device carried.
[0004] However, when its attention is paid only to the phase after the substrate carrying thin film devices, such as TFT, is completed, above-mentioned "substrate" is not sometimes necessarily desirable.
[0005] For example, although a quartz substrate, a heat-resisting glass substrate, etc. are used as mentioned above when passing through the manufacture process accompanied by high temperature processing, these are very expensive, therefore cause the rise of a product price.
[0006] Moreover, a glass substrate has the property for it to be heavy and to be easy to be divided. Although what cannot break easily even if it is cheap as much as possible, it is light and it bears and drops also on deformation of some with the liquid crystal display used for portable electronic devices, such as a palmtop computer and a portable telephone, is desirable, actually, a glass substrate is heavy, and is weak to deformation, and it is common that there is fear of destruction by fall.
[0007] That is, it was very difficult for a slot to be between the desirable properties required of the constraint which comes from manufacture conditions, and a product, and to satisfy the conditions and property of these both sides to it.
[0008] Then, an applicant for this patent has proposed the technique of exfoliating from the 1st substrate and making the 2nd substrate imprinting this thin film device, after forming a thin film device on the 1st substrate in the conventional process (Japanese Patent Application No. No. 225643 [eight to]). For this reason, the detached core is formed between the 1st substrate and the thin film device which is a transferred layer. The thin film device which is a transferred layer is made to exfoliate from the 1st substrate, and this transferred layer is made to imprint to a 2nd substrate side by irradiating light at this detached core.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] According to the experiment of this invention person, when making a thin film device exfoliate from the 1st substrate, it was discovered that an exfoliation phenomenon may not fully arise in a detached core only by irradiating light at a detached core.
[0010] And it became clear that it was [of this invention person] dependent on the property of a detached core wholeheartedly whether it is easy to produce this exfoliation phenomenon according to research.
[0011] Furthermore, the technical problem that it will differ mutually had the laminating relation of the transferred layer to the 1st substrate used when manufacturing a transferred layer, and the laminating relation of the transferred layer to the 2nd substrate which is the imprint place of the transferred layer.
[0012] Then, this invention is to offer the thin film device, active-matrix substrate, and liquid crystal display which use it for the exfoliation approach list of a thin film device compensate [list] that it will be in the condition that a detached core tends to exfoliate, and it was made to make a thin film device exfoliate easily from a substrate, and are manufactured in front of the process which makes a detached core produce an exfoliation phenomenon in exfoliation.
[0013] Other purposes of this invention are to offer the imprint approach of the thin film device which can make in agreement the laminating relation of the transferred layer to the substrate used at the time of manufacture of a transferred layer, and the laminating relation of the transferred layer to the imprint object which is the imprint place of the transferred layer.

[Translation done.]

MEANS

[Means for Solving the Problem] The 1st process at which invention according to claim 1 forms a detached core on a substrate, and the 2nd process which forms a thin film device on said detached core, An exfoliation phenomenon is produced in the inside of the layer of said detached core, and/or an interface, and it is characterized by preparing like ion grouting which pours ion into said detached core before said 3rd process in the exfoliation approach of a thin film device of having the 3rd process which makes said substrate exfoliating from said detached core.
[0015] The detached core which has the property which absorbs light that the dependability in device manufacture is high, on substrates, such as a quartz substrate, is prepared, for example, and thin film devices, such as TFT, are formed on the substrate. It joins to the imprint object of a request of a thin film device through the glue line preferably next. Light is irradiated after that at a detached core, and it produces and cheats out of an exfoliation phenomenon in the detached core. Thereby, a thin film device can be made to exfoliate from a substrate by applying the force to a substrate.
[0016] The exfoliation phenomenon of the detached core in an exfoliation process can become remarkable, and a thin film device can be made to exfoliate from a substrate certainly by pouring ion into a detached core in front of an exfoliation process at this time.
[0017] Here, by pouring ion into a detached core beforehand, the operation defined as either of claims 2-5 is made, and the exfoliation phenomenon of a detached core becomes remarkable.
[0018] According to claim 2, the process by which said ion poured into said detached core is gasificated is included in said three processes. If the ion in a detached core is gasificated, in a detached core, internal pressure will arise and the exfoliation phenomenon will be promoted.
[0019] In this case, light can be irradiated at a detached core and the ion for exfoliation can be made to gasificate by that light, as shown in claim 3. If an optical exposure is carried out at this time [side / of a substrate / rear-face], the quantity of light by which optical incidence is carried out to a thin film device layer can be reduced, and degradation of that property can be prevented.
[0020] According to claim 4, like said ion grouting, association of the atom or molecule which constitutes said detached core with said ion is cut, and a damage is beforehand given to said detached core. Therefore, the exfoliation phenomenon in the detached core produced at a subsequent exfoliation process is promoted.
[0021] According to claim 5, like said ion grouting, the property of said detached core is changed with said ion, and the adhesion of said detached core and said substrate is weakened beforehand. Therefore, the exfoliation phenomenon in the detached core produced at a subsequent exfoliation process is promoted.
[0022] Invention of claim 6 has a thin film transistor formation process for said 2nd process to form a thin film transistor in claim 1 thru/or either of 5, and said thin film transistor formation process is characterized by carrying out after said channel layer formation process like said ion grouting including a channel layer formation process.
[0023] A channel formation process turns into a high-temperature-processing process as compared with other processes. Therefore, it is because there is a possibility that ion may be emitted from a detached core at the time of subsequent high temperature processing when the

ion for exfoliation phenomenon promotion is poured in before that at the detached core.
[0024] Invention of claim 7 is characterized by carrying out said thin film transistor formation process after said channel pattern formation process like said ion grouting including a channel pattern formation process after said channel layer formation process in claim 6.
[0025] If the channel pattern is formed, even if it pours in the ion for exfoliation phenomenon promotion from a channel pattern side, the area of the channel pattern itself which can serve as a failure of the impregnation will decrease. Therefore, it becomes that it is easy to make ion reach to a detached core.
[0026] Invention of claim 8 is characterized by forming a mask among said channel layers on a channel field and the becoming field, and carrying out like said ion grouting in claims 6 or 7.
[0027] It is because there is a possibility that transistor characteristics may deteriorate when ion is poured into a channel field. In addition, the process which carries out the mask of the channel field and carries out an ion implantation may be before channel pattern formation or after formation.
[0028] In claim 9, said thin film transistor formation process is characterized by carrying out like said ion grouting by using said gate electrode as a mask after said channel pattern formation process including the process which forms gate dielectric film on this channel pattern, and the process which forms a gate electrode on this gate dielectric film in claim 7.
[0029] Since a gate electrode is formed in a channel and the location which counters, a gate electrode can be used also [field / channel] as a mask with which ion prevents pouring into a channel field. In addition, according to the acceleration voltage of ion, a mask may be further formed on a gate electrode.
[0030] Invention of claim 10 is characterized by pouring into coincidence the impurity ion driven into either [at least] the source field in said channel pattern, or a drain field, and said ion which mass is lighter than it and is driven into said detached core like said ion grouting in claims 8 or 9.

[0031] If it carries out like this, it can be made to serve a double purpose like impurity ion grouting to the source and/or a drain field like ion grouting to a detached core. In addition, since mass is lighter than impurity ion, ion can reach to the detached core in a location deeper than the source and a drain field.
[0032] Invention of claim 11 is characterized by carrying out said thin film transistor formation process in front of said crystallization process like said ion grouting including the process which forms an amorphous silicon layer as said channel layer, and the crystallization process which carries out laser annealing of the account amorphous silicon layer of back to front, and is crystallized in claim 6.
[0033] Crystallinity is raised by the subsequent laser annealing process even if a damage should arise in a channel layer by operation like ion grouting.
[0034] Invention of claim 12 is characterized by said ion being a hydrogen ion in claim 1 thru/or either of 11.
[0035] If a hydrogen ion is poured into a detached core, it can be made to contribute to the operation shown in each of claims 2-4. Since mass is lighter than the source and the impurity ion (boron, Lynn, etc.) driven into a drain, especially the hydrogen ion also fits implementation of invention of claim 9. In addition, as ion which mainly produces gasification of claim 2, nitrogen ion etc. can be mentioned other than a hydrogen ion. Moreover, as ion which mainly produces the damage of claims 3 and 4, or an adhesion fall, Si ion etc. can be mentioned other than a hydrogen ion.
[0036] Invention of claim 13 is characterized by said ion grouting making process temperature of the process carried out behind less than 350 degrees C in claim 12.
[0037] Since it begins to escape from the hydrogen poured into the detached core by being heated by 350 degrees C or more, as for the process which needs the process temperature of 350 degrees C or more, it is as desirable as ion grouting to a detached core to carry out in front.

[0038] Invention of claim 14 defines the thin film device which uses the exfoliation approach of ** for claim 1 thru/or either of 13, exfoliates from said substrate, and changes. Since the

exfoliation from a detached core is easy for this thin film device, there is little mechanical pressure which acts at the time of exfoliation, it ends, and can lessen the defect depending on the magnitude of that load.
[0039] Invention of claim 15 is a active-matrix substrate with which the pixel section is constituted including the thin film transistor arranged in the shape of a matrix, and the pixel electrode connected to the end of the thin film transistor, and defines the active-matrix substrate manufactured by imprinting the thin film transistor of said pixel section using an approach according to claim 6 to 13.
[0040] This active-matrix substrate as well as invention of claim 13 can lessen a defect.
[0041] Invention of claim 16 defines the liquid crystal display manufactured using the active-matrix substrate according to claim 15.
[0042] Since the active-matrix substrate of claim 15 is used for this liquid crystal display, its defect as the whole liquid crystal display also decreases.
[0043] The imprint approach of the thin film device concerning invention of claim 17 The 1st process which forms the 1st detached core on a substrate, and the 2nd process which forms the transferred layer containing a thin film device on said 1st detached core, The 3rd process which forms the 2nd detached core which consists of water solubility or organic solvent melting nature adhesives on said transferred layer, It borders on said 1st detached core at the 4th process which joins a primary imprint object on said 2nd detached core. The 5th process which removes said substrate from said transferred layer, and the 6th process which joins a secondary imprint object to the inferior surface of tongue of said transferred layer, Said 2nd detached core is contacted to water or an organic solvent, and it has the 7th process which removes said primary imprint object from said transferred layer bordering on said 2nd detached core, and is characterized by imprinting said transferred layer containing said thin film device on a secondary imprint object.
[0044] After removing the 1st detached core and joining a secondary imprint object to the inferior surface of tongue from the inferior surface of tongue of a transferred layer, it is made to secede from a primary imprint object from a transferred layer bordering on the 2nd detached core according to invention of claim 17. If it carries out like this, a secondary imprint object will exist in the location in which the original substrate was located to a transferred layer, and the laminating relation of the transferred layer to the original substrate and the laminating relation of the transferred layer to a secondary imprint object are in agreement. here, since water-soluble adhesives or organic solvent melting nature adhesives is used as the 2nd detached core, the 2nd detached core is contacted to water or an organic solvent making it secede from a primary imprint object — being sufficient .
[0045] By the imprint approach of the thin film device concerning invention of claim 18, as the 2nd detached core under approach invention of claim 17, it replaces with the above-mentioned adhesives and the adhesives which can exfoliate by heating or ultraviolet rays are used.
[0046] In this case, if the 2nd detached core is contacted in the adhesives which can exfoliate by heating or ultraviolet rays making it secede from a primary imprint object, the laminating relation of the transferred layer to the original substrate and the laminating relation of the transferred layer to a secondary imprint object can be made in agreement like invention of claim 17.
[0047]
[Embodiment of the Invention] Next, the gestalt of operation of this invention is explained with reference to a drawing.
[0048] <Gestalt of the 1st operation> drawing 1 - drawing 6 are drawings for explaining the imprint approach of the thin film device which will be the requisite for this invention.
[0049] As shown in [process 1] drawing 1 , a detached core (light absorption layer) 120 is formed on a substrate 100.
[0050] Hereafter, a substrate 100 and a detached core 120 are explained.
[0051] ** What has the translucency which light may penetrate is used for the explanation substrate 100 about a substrate 100.
[0052] In this case, as for the permeability of light, it is desirable that it is 10% or more, and it is

more desirable that it is 50% or more. When this permeability is too low, attenuation (loss) of light becomes large and needs the big quantity of light by exfoliating a detached core 120.

[0053] Moreover, as for a substrate 100, it is desirable to consist of reliable ingredients, and it is desirable to consist of ingredients which were excellent in thermal resistance especially. Although the reason has what process temperature becomes high depending on the class and formation approach (for example, about 350-1000 degrees C) in case it forms the transferred layer 140 and interlayer 142 who mention later, it is because the width of face of a setup of membrane formation conditions, such as the temperature condition, will spread even in such a case on the occasion of formation of the transferred layer 140 grade to a substrate 100 top if the substrate 100 is excellent in thermal resistance.

[0054] Therefore, a substrate 100 has a desirable consisting-of [the strain point]-ingredients more than Tmax thing, when the maximum temperature in the case of formation of the transferred layer 140 is set to Tmax. A thing 350 degrees C or more has a desirable strain point, and, specifically, the component of a substrate 100 has a more desirable thing 500 degrees C or more. As such a thing, the heat resisting glass of quartz glass, Corning 7059, and NEC glass OA-2 grade is mentioned, for example.

[0055] Moreover, although especially the thickness of a substrate 100 is not limited, it is desirable that it is about 0.1-5.0mm, and it is usually more desirable that it is about 0.5-1.5mm. If the thickness of a substrate 100 is too thin, a strong fall will be caused, and if too thick, when the permeability of a substrate 100 is low, it will become easy to produce attenuation of light. In addition, when the permeability of the light of a substrate 100 is high, the thickness may exceed said upper limit. In addition, as for the thickness of a substrate 100, it is desirable that it is uniform so that light can be irradiated at homogeneity.

[0056] ** The explanation detached core 120 of a detached core 120 is receiving any one or two or more operations of physical operations (light, heat, etc.), chemical operations (chemical reaction with a drug solution etc.), or mechanical works (hauling force, vibration, etc.), that bonding strength is decreased or extinguished and this urges separation of a substrate 100 to it through this detached core 120.

[0057] The light which it considers as this detached core 120, for example, is irradiated can be absorbed, and what has a property which produces exfoliation (henceforth "exfoliation in a layer" and "interfacial peeling") in the inside of that layer and/or an interface can be mentioned. What it arises that the bonding strength between the atoms of the matter which constitutes a detached core 120, or between molecules disappears or decreases, i.e., ablation, and results in the exfoliation in a layer and/or interfacial peeling by the exposure of light preferably is good.

[0058] Furthermore, a gas may be emitted by the exposure of light from a detached core 120, and the separation effectiveness may be discovered. That is, a detached core 120 absorbs light, it becomes a gas to the case where the component contained in the detached core 120 serves as a gas, and it is emitted for a moment, the steam is emitted, and it may contribute to separation.

[0059] In this invention, after forming the detached core 120 which has such a property, it is the description to pour in the ion for exfoliation promotion into a detached core 120, and, thereby, the exfoliation phenomenon in the detached core 120 in a subsequent process is promoted. Therefore, a class will not be asked if the exfoliation phenomenon by the physical operation, chemical operation, or mechanical work mentioned above is promoted as ion for exfoliation promotion.

[0060] Next, as a presentation of such a detached core 120, what is indicated by following A-E is mentioned, for example.

[0061] A. Amorphous silicon (a-Si)

Hydrogen (H) may contain in this amorphous silicon. In this case, as for the content of H, it is desirable that it is extent more than 2 atom %, and it is more desirable that it is 2 - 20 atom % extent. Thus, if specified quantity content of the hydrogen (H) is carried out, by making light an exposure behind, hydrogen will be emitted, internal pressure will occur in a detached core 120, and it will become the force in which it exfoliates an up-and-down thin film. The content of the hydrogen in an amorphous silicon (H) can be adjusted by setting up suitably conditions, such as

membrane formation conditions, for example, the gas presentation in CVD, gas pressure, a gas ambient atmosphere, a quantity of gas flow, temperature, substrate temperature, and injection power.

[0062] With the gestalt of this operation, the ion implantation of the hydrogen ion can be carried out as ion for exfoliation promotion at one after formation of an amorphous silicon layer of stages as hydrogen is made to contain in a detached core 120 according to this process condition and also being mentioned later. Thereby, the hydrogen more than a constant rate can be made to contain in an amorphous silicon layer, without being influenced by the process conditions of an amorphous silicon.

[0063] B. As various oxide ceramics, such as silicon oxide or a silicic-acid compound, titanium oxide or a titanic-acid compound, a zirconium dioxide or a zirconic acid compound, a lanthanum trioxide, or a lanthanum oxidation compound, ****** (ferroelectric), or semi-conductor silicon oxide, SiO, SiO2, and Si 3O2 are mentioned, and K2SiO3, Li2SiO3, CaSiO3 and ZrSiO4, and Na2SiO3 are mentioned as a silicic-acid compound, for example.

[0064] TiO, Ti203, and Ti02 mention as titanium oxide — having — as a titanic-acid compound -- BaTi04, BaTiO3, Ba2Ti 9O20, BaTi 5O11, and CaTiO3, SrTiO3, PbTiO3, MgTiO3, ZrTiO2, SnTiO4 and aluminum2 — TiO5 and FeTiO3 are mentioned.

[0065] As a zirconium dioxide, ZrO2 is mentioned and BaZrO3, ZrSiO4, PbZrO3, MgZrO3, and K2ZrO3 are mentioned as a zirconic acid compound, for example.

[0066] C. The ceramics or dielectrics (ferroelectric), such as PZT, PLZT, PLLZT, and PBZT
D. As nitride-ceramics E. organic polymeric-materials organic polymeric materials, such as silicon nitride, nitriding aluminum, and titanium nitride - CH-, -CO- (ketone), -CONH- (amide), -NH- (imide), - As long as it is what has association (these association is cut by the exposure of light) of COO- (ester), -N=N- (azo), -CH=N- (CIF), etc., and the thing which has many these association especially, what kind of thing may be used. Moreover, organic polymeric materials may have aromatic hydrocarbon (1, two or more benzene rings, or condensed ring of those) in a constructive mood.

[0067] As an example of such organic polymeric materials, polyethylene, polyolefine like polypropylene, polyimide, a polyamide, polyester, polymethylmethacrylate (PMMA), polyphenylene sulfide (PPS), polyether sulphone (PES), an epoxy resin, etc. are raised.

[0068] F. As a metal metal, the alloy containing at least one of aluminum, Li, Ti, Mn, In, Sn, Y, La, Ce, Nd, Pr, Gd, Sm, or sorts of these is mentioned, for example.

[0069] Moreover, although the thickness of a detached core 120 changes with terms and conditions, such as a presentation of the exfoliation purpose or a detached core 120, lamination, and the formation approach, it is desirable that it is 1nm - about 20 micrometers, it is more desirable that it is 5nm - about 2 micrometers, and it is usually still more desirable [thickness] that it is 5nm - about 1 micrometer. While enlarging power (quantity of light) of light in order to secure the good detachability of a detached core 120 if the homogeneity of membrane formation is spoiled, nonuniformity may arise in exfoliation, when the thickness of a detached core 120 is too small, and thickness is too thick, in case a detached core 120 is removed behind, the activity takes time amount. In addition, as for the thickness of a detached core 120, it is desirable that it is uniform as much as possible.

[0070] Especially the formation approach of a detached core 120 is not limited, but is suitably chosen according to terms and conditions, such as a film presentation and thickness. For example, it CVD(s) (MOCVD and low voltage — CVD and ECR-CVD are included). Vacuum evaporationo, molecular beam deposition (MB), sputtering, ion plating, The various gaseous-phase forming-membranes methods, such as PVD, electroplating, immersion plating (dipping), various plating, such as electroless deposition, and the Langmuir pro jet (LB) — law — The applying methods, such as a spin coat, a spray coat, and a roll coat, various print processes, a replica method, the ink jet method, a powder jet process, etc. are mentioned, and it can also form or more [of these] combining two.

[0071] For example, when the presentation of a detached core 120 is an amorphous silicon (a-Si), it is desirable to form membranes by CVD especially low voltage CVD, or plasma CVD.

[0072] Moreover, when a detached core 120 is constituted from ceramics by the sol-gel method,

or when it constitutes from organic polymeric materials, it is desirable the applying method and to form membranes with a spin coat especially.

[0073] As shown in [a process 2], next drawing 2 , the transferred layer (thin film device layer) 140 is formed on a detached core 120. Although the detail after this process 2 is later explained with reference to drawing 8 - drawing 18 , it is carrying out like ion grouting for exfoliation promotion to a detached core 120 with the gestalt of this operation in the middle of the process of drawing 8 - drawing 13 .

[0074] The expanded sectional view of K part (part shown by surrounding with 1 dotted-line chain line in drawing 2) of this thin film device layer 140 is shown in the right-hand side of drawing 2 . It is constituted including TFT (thin film transistor) formed on SiO2 film (middle class) 142, and the thin film device layer 140 possesses the source and the drain layer 146 which this TFT introduced n mold impurity into the polish recon layer, and were formed, the channel layer 144, gate dielectric film 148, the gate electrode 150, an interlayer insulation film 154, and the electrode 152 that consists of aluminum so that it may be illustrated.

[0075] Although Si02 film is used with the gestalt of this operation as an interlayer prepared in contact with a detached core 120, the insulator layer of others, such as Si3N4, can also be used. Although the thickness of Si02 film (interlayer) is suitably determined according to the formation purpose or extent of a function which can be demonstrated, it is desirable that it is 10nm - about 5 micrometers, and it is usually more desirable that it is 40nm - about 1 micrometer. What demonstrates at least one of the functions as the protective layer which an interlayer is formed for the various purpose, for example, protects the transferred layer 140 physically or chemically, an insulating layer, a conductive layer, the protection-from-light layer of laser light, the barrier layer for migration prevention, and a reflecting layer is mentioned.

[0076] In addition, the middle class, such as Si02 film, may not be formed depending on the case, but the direct transferred layer (thin film device layer) 140 may be formed on a detached core 120.

[0077] The transferred layer 140 (thin film device layer) is a layer containing thin film devices, such as TFT as shown in the right-hand side of drawing 2 .

[0078] As a thin film device, besides TFT, for example, a thin-film diode, The optoelectric transducer (the photosensor, solar battery) and silicon resistance element which consist of PIN junction of silicon, Other thin film semiconductor devices, an electrode (example: a transparent electrode like ITO and the mesa film), Actuators, such as a switching element, memory, and a piezoelectric device, a micro mirror (piezo thin film ceramics), There are a micro MAG device which combined a magnetic-recording thin film head, a coil, an inductor, the charge of a thin film quantity magnetic-permiable material, and them, a filter, reflective film, a dichroic mirror, etc.

[0079] Such a thin film device is formed through usually comparatively high process temperature by relation with the formation approach. Therefore, as mentioned above in this case, as a substrate 100, the thing which has high dependability and which can bear that process temperature is needed.

[0080] As shown in [a process 3], next drawing 3 , the thin film device layer 140 is joined to the imprint object 180 through a glue line 160 (adhesion).

[0081] As a suitable example of the adhesives which constitute a glue line 160, various hardening mold adhesives, such as photo-curing mold adhesives, such as reaction hardening mold adhesives, heat-curing mold adhesives, and ultraviolet curing mold adhesives, and aversion hardening mold adhesives, are mentioned. As a presentation of adhesives, what kind of thing is sufficient as an epoxy system, an acrylate system, a silicone system, etc., for example. Formation of such a glue line 160 is made for example, by the applying method.

[0082] After applying hardening mold adhesives on the transferred layer (thin film device layer) 140 and joining the imprint object 180 on it when using said hardening mold adhesives for example, said hardening mold adhesives are stiffened by the hardening approach according to the property of hardening mold adhesives, and the transferred layer (thin film device layer) 140 and the imprint object 180 are pasted up, and it fixes.

[0083] when adhesives are photo-curing molds, light is irradiated from the substrate of light transmission nature, and both the outsides of an imprint object or — from one outside of the

substrate 100 of light transmission nature, or the imprint object 180 of light transmission nature. As adhesives, photo-curing mold adhesives, such as an ultraviolet curing mold which cannot affect a thin film device layer easily, are desirable.

[0084] Water-soluble adhesives can also be used as a glue line 160. As this kind of water-soluble adhesives, it is KEMISHIRU made from for example, KEMITEKKU, Inc. Three Bond 3046 (trade name) by U-451D (trade name) and Three Bond Co., Ltd. etc. can be mentioned.

[0085] The adhesives which have melting nature to various kinds of organic solvents as a glue line 160 can also be used.

[0086] As a glue line 160, the adhesives which present an exfoliation operation with heating can also be used. As this kind of adhesives, RIBAARUFA made from for example, Japanese east DENKO (trade name) can be used.

[0087] As a glue line 160, the adhesives which present an exfoliation operation by UV irradiation can also be used. As this kind of adhesives, the dicing tape D-210 for glass ceramics by LINTEC Corp. and D-636 can be used.

[0088] In addition, unlike illustration, a glue line 160 may be formed in the imprint object 180 side, and the transferred layer (thin film device layer) 140 may be pasted up on it. In addition, when imprint object 180 the very thing has an adhesion function, for example, formation of a glue line 160 may be omitted.

[0089] although not limited especially as an imprint object 180 — a substrate (plate) — especially a transparence substrate is mentioned. In addition, such a substrate may be monotonous or may be a curve plate. Moreover, compared with said substrate 100, properties, such as thermal resistance and corrosion resistance, may be inferior in the imprint object 180. It is because the reason forms the transferred layer (thin film device layer) 140 in a substrate 100 side in this invention, and imprints the transferred layer (thin film device layer) 140 on the imprint object 180 after that, so it does not depend on the temperature conditions in the case of formation of the transferred layer (thin film device layer) 140 etc. for the property required of the imprint object 180, especially thermal resistance.

[0090] Therefore, when the maximum temperature in the case of formation of the transferred layer 140 is set to Tmax, a glass transition point (Tg) or softening temperature can use the following [Tmax] as a component of the imprint object 0. For example, a glass transition point (Tg) or softening temperature can constitute more preferably 800 degrees C or less of 500 degrees C or less of imprint objects 180 from an ingredient 320 degrees C or less still more preferably.

[0091] Moreover, although what has a certain amount of rigidity (reinforcement) as a mechanical property of the imprint object 180 is desirable, you may have flexibility and elasticity.

[0092] As a component of such an imprint object 180, various synthetic resin or various glass material are mentioned, and various synthetic resin and the usual cheap glass material (low melting point) are desirable especially.

[0093] As synthetic resin, any of thermoplastics and thermosetting resin are sufficient. For example, polyethylene, a polo propylene, an ethylene-pre pyrene copolymer, Polyolefines, such as an ethylene-vinylacetate copolymer (EVA), annular polyolefine, Denaturation polyolefine, a polyvinyl chloride, a polyvinylidene chloride, polystyrene, A polyamide, polyimide, polyamidoimide, a polycarbonate, Polly (4-methyl BENTEN -1), An ionomer, acrylic resin, polymethylmethacrylate, an acrylic-styrene copolymer (AS resin), Butadiene Styrene, a polio copolymer (EVOH), polyethylene terephthalate (PET), Polyester, such as polyp CHIREN terephthalate (PBT) and PURISHI clo hexane terephthalate (PCT), A polyether, a polyether ketone (PEK), a polyether ether ketone (PEEK), Polyether imide, polyacetal (POM), polyphenylene oxide, Denaturation polyphenylene oxide, polyarylate, aromatic polyester (liquid crystal polymer), Polytetrafluoroethylene, polyvinylidene fluoride, other fluorine system resin, A styrene system, a polyolefine system, a polyvinyl chloride system, a polyurethane system, Various thermoplastic elastomer, such as a fluororubber system and a chlorinated polyethylene system, EBOKISHI resin, phenol resin, a urea resin, melamine resin, unsaturated polyester, The copolymer which is mainly concerned with these, a blend object, a polymer alloy, etc. are mentioned, and silicone resin, polyurethane, etc. can be used combining 1 of sorts of these, and two sorts or more (as a

layered product for example, more than two-layer).
[0094] As glass material, silicic-acid glass (quartz glass), silicic-acid alkali glass, soda lime glass, potash lime glass, lead (alkali) glass, barium glass, borosilicate glass, etc. are mentioned, for example. Among these, compared with silicic-acid glass, the melting point is low, and shaping and processing are also comparatively easy the melting point, and, moreover, things other than silicic-acid glass have it, and are desirable. [cheap]
[0095] When using what consisted of synthetic resin as an imprint object 180, while being able to fabricate the large-scale imprint object 180 in one, even if it is complicated configurations, such as what has a curve side and irregularity, it can manufacture easily, and the various advantages that ingredient cost and a manufacturing cost are also cheap can be enjoyed. Therefore, use of synthetic resin is advantageous when manufacturing a large-sized and cheap device (for example, liquid crystal display).
[0096] In addition, the imprint object 180 may constitute some devices like what constitutes the device which became independent in itself like a liquid crystal cell, a color filter and an electrode layer, a dielectric layer, an insulating layer, and a semiconductor device.
[0097] Furthermore, the imprint objects 180 may be matter, such as a metal, ceramics, a stone, and wood paper, and may be on the front face of the structures, such as a wall, a column, head lining, and a windowpane, further on the field of the arbitration which constitutes a certain article (superiors of the front-face top of the field top of a clock, and an air-conditioner, and a printed circuit board).
[0098] As shown in [a process 4], next drawing 4 , light is irradiated from the rear-face side of a substrate 100.
[0099] After this light penetrates a substrate 100, it is irradiated by the detached core 120. Thereby, the exfoliation in a layer and/or interfacial peeling arise in a detached core 120, and bonding strength is decreased or extinguished.
[0100] It is presumed that it is what is depended on phase changes, such as that ablation produces the principle which the exfoliation in a layer and/or interfacial peeling of a detached core 120 produce in the component of a detached core 120 and emission of the gas contained in the detached core 120, melting further produced immediately after an exposure, and evapotranspiration.
[0101] The fixed ingredient (component of a detached core 120) which absorbed exposure light is excited photochemistry-wise or thermally, ablation means association of the atom of the front face and interior or a molecule being cut, and emitting here, and it mainly appears as a phenomenon in which all or a part of component of a detached core 120 produces phase changes, such as melting and evapotranspiration (evaporation). Moreover, by said phase change, it may be in a minute firing condition and bonding strength may decline.
[0102] Conditions, such as a presentation of a detached core 120, and a class of light irradiated as one of the factor of the, wavelength, reinforcement, the attainment depth, are mentioned by in addition to this being influenced by various factors they are [whether a detached core 120 produces the exfoliation in a layer interfacial peeling is produced, or] the both.
[0103] Here, with the gestalt of this operation, after formation of a detached core 120, in order to make detached core 120 the very thing produce an exfoliation phenomenon more certainly at this 4th process, the ion for exfoliation promotion is poured in.
[0104] This ion for exfoliation promotion promotes three either of the followings, or the exfoliation phenomenon of the detached core [in / for an operation of two or more combination / nothing and the 4th process] 120 at least.
[0105] The ion for exfoliation promotion, for example, the hydrogen, (H) or nitrogen (N) with which one of them was poured into the detached core 120 by operation of this 4th process is gasificated, and, thereby, exfoliation of a detached core 120 is promoted.
[0106] Other one was set like ion grouting for exfoliation promotion, it cut association of the atom or molecule which constitutes a detached core 120 with the ion for exfoliation promotion, for example, hydrogen, (H), nitrogen (N), or silicon (Si), and has given the damage beforehand to the detached core 120. Therefore, in the detached core 120 to which the damage was given beforehand, exfoliation arises comparatively easily by operation of the 4th process.

[0107] One of further others is set like ion grouting for exfoliation promotion, it changes the property of a detached core 120 with the ion for exfoliation promotion, for example, hydrogen, (H), nitrogen (N), or silicon (Si), and the adhesion of a detached core 120 and a substrate 100 has weakened it beforehand. Also in this case, in the detached core 120 which the adhesion with a substrate was able to weaken, exfoliation arises comparatively easily by operation of the 4th process.
[0108] As a light irradiated at the 4th process, if a detached core 120 is made to start the exfoliation in a layer, and/or interfacial peeling, what kind of thing may be used, for example, an X-ray, ultraviolet rays, the light, infrared radiation (heat ray), a laser beam, a millimeter wave, microwave, an electron ray, a radiation (alpha rays, beta rays, gamma ray), etc. will be mentioned. A laser beam is desirable at the point of being easy to produce exfoliation (ablation) of a detached core 120 also in it.
[0109] As laser equipment made to generate this laser beam, although various gas laser, solid state laser (semiconductor laser), etc. are mentioned, excimer laser, Nd-YAG laser, Ar laser, a CO2 laser, a CO laser, helium-Ne laser, etc. are used suitably, and especially excimer laser is desirable also in it.
[0110] Since it outputs high energy in a short wavelength region, extremely, excimer laser can make a detached core 120 produce ablation for a short time, and it can exfoliate a detached core 120, without making the imprint object 180 and substrate 100 grade which therefore adjoin produce most temperature rises (i.e., without it producing degradation and damage).
[0111] Moreover, when it makes it faced that a detached core 120 produces ablation and there is a wavelength dependency of light, as for the wavelength of the laser beam irradiated, it is desirable that it is 100nm - about 350nm.
[0112] An example of permeability to the wavelength of light of a substrate 100 is shown in drawing 7 . It has the property that permeability increases steeply to the wavelength of 200nm so that it may be illustrated. In such a case, light (wavelength of 308nm) with a wavelength of 210nm or more, for example, Xe-Cl excimer laser light, KrF laser light (wavelength of 248nm), etc. are irradiated.
[0113] Moreover, when making a detached core 120 cause phase changes, such as a gas evolution, evaporation, and sublimation, and giving a separation property to it, as for the wavelength of the laser beam irradiated, it is desirable that it is about 350 to 1200nm.
[0114] Moreover, as for especially the energy density in the case of excimer laser, it is desirable the energy density of the laser beam irradiated and to consider as about two 10 - 5000 mJ/cm, and it is more desirable to consider as about two 100 - 500 mJ/cm. Moreover, as for irradiation time, it is desirable to be referred to as about 1 - 1000ns, and it is more desirable to be referred to as about 10 - 100ns. When sufficient ablation etc. does not arise, and an energy density is high, when an energy density is low or irradiation time is short, or irradiation time is long, there is a possibility of having a bad influence on the transferred layer 140 by the exposure light which penetrated the detached core 120.
[0115] In addition, as a cure in case the exposure light which penetrated the detached core 120 reaches even the transferred layer 140 and does a bad influence, as shown in drawing 30 , there is the approach of forming the metal membranes 124, such as a tantalum (Ta), on a detached core (laser absorption layer) 120, for example. Thereby, it is completely reflected by the interface of a metal membrane 124, and the laser light which penetrated the detached core 120 does not have a bad influence on the thin film device above it.
[0116] Next, the force is applied to a substrate 100 and this substrate 100 is made to secede from a detached core 120, as shown in drawing 5 . Although not illustrated in drawing 5 , a detached core may adhere on a substrate 100 after this balking.
[0117] Next, as shown in drawing 6 , the extant detached core 120 is removed by the approach which combined approaches, such as washing, etching, ashing, and polish, or these. It means that the transferred layer (thin film device layer) 140 had been imprinted by the imprint object 180 by this.
[0118] In addition, when a part of detached core has adhered also to the substrate 100 from which it seceded, it removes similarly. In addition, when the substrate 100 consists of an

expensive ingredient like quartz glass, and a rare ingredient, reuse (recycle) is preferably presented with a substrate 100. That is, this invention can be applied to the substrate 100 to reuse, and usefulness is high.

[0119] The imprint to the imprint object 180 of the transferred layer (thin film device layer) 140 is completed through each above process. Then, conductive layers, such as removal of SiO2 film which adjoins the transferred layer (thin film device layer) 140, and wiring of a up to [the transferred layer 140], formation of a desired protective coat, etc. can also be performed.

[0120] Thus, transferred layer (thin film device layer) 140 the very thing which is an exfoliated object is not exfoliated directly. Since it exfoliates in the detached core joined to the transferred layer (thin film device layer) 140, Irrespective of the property of an exfoliated object (transferred layer 140), conditions, etc., easily and certainly, it can exfoliate in homogeneity (imprint), there is also no damage to the exfoliated object (transferred layer 140) in accordance with exfoliation actuation, and the high dependability of the transferred layer 140 can be maintained.

[0121] Next, TFT of for example, CMOS structure is formed as a thin film device layer 140 on a substrate 100 and a detached core 120, and the example of the concrete manufacture process in the case of imprinting this on an imprint object is explained using drawing 8 – drawing 18 . In addition, even if it attaches like ion grouting for exfoliation promotion carried out in the middle of this process, it explains.

[0122] (Process 1) as shown in drawing 8 , on the translucency substrate (for example, quartz substrate) 100, laminating formation of a detached core (for example, LPCVD amorphous silicon layer formed of law) 120, an interlayer (for example, SiO2 film) 142, and the amorphous silicon layer (for example, LPCVD — formed of law) 143 is carried out one by one, then laser light is irradiated from the upper part all over the amorphous silicon layer 143, and annealing is given. Thereby, the amorphous silicon layer 143 is recrystallized and turns into a polish recon layer. In addition, when carrying out laser annealing in this case with a beam scan, it is desirable in the same part that an optical exposure is carried out 2 times or more so that the beam cores of the beam of each time may lap unlike the beam scan to the above-mentioned detached core 120 (it removes in the case of a Gaussian beam). In this case, it is because there are no evils, such as optical leakage, and the amorphous silicon layer 143 can fully be recrystallized by carrying out a multiplex exposure.

[0123] If it is after formation of a detached core 120 and is before the laser annealing process for crystallization as an operation stage of the impregnation process of the ion for exfoliation promotion, it is desirable at the point that an ion implantation can be carried out without needing a mask.

[0124] Therefore, as the operation stage, it is after formation of the detached core 120 of (A) drawing 8 , is after formation of an interlayer's 142 (B) interlayer 142 before formation, is after formation of the amorphous silicon layer 143 (before [C]) formation of the amorphous silicon layer 143, and becomes either in front of the laser annealing process for the crystallization. This (A) In – (C), the operation stage of (C) is the most desirable. In the reason, the formation process of the amorphous silicon layer 143, i.e., the formation process of a channel layer, serves as process temperature of about 425 degrees C in the present condition. When the hydrogen ion is already poured into the detached core 120 as in this case, for example, ion for exfoliation promotion, there is a possibility that hydrogen may escape from and come out of a detached core 120 at the temperature of 350 degrees C or more. Therefore, as for the impregnation process of the ion for exfoliation promotion, it is desirable to carry out with the operation stage after the channel stratification (C). However, since there is such no limit depending on the class of ion for exfoliation promotion, an operation stage (A) and (B) can also be carried out. Moreover, it is desirable on transistor characteristics that the damage resulting from impregnation of the ion for exfoliation promotion has not arisen in the layer after laser annealing of the amorphous silicon layer 143 was carried out and it was polycrystal-ized. In being (C), even if there is no generating of a damage itself in (A) and (B), and a damage arises in amorphous silicon layer 143 the very thing, the effect of the damage will be reduced according to a subsequent crystallization process.

[0125] In addition, like this ion grouting for exfoliation promotion, it can carry out using well-

known ion implantation equipment. That is, if a hydrogen ion is poured in, for example, the gas containing hydrogen is plasma-ized and the hydrogen ion generated by it can be poured into a detached core 120 by accelerating by electric field.
[0126] As an operation stage like ion grouting (D), you may be after laser annealing. In this case, transistor characteristics will not be degraded, if the mask of the part used as a channel field is carried out and it carries out an ion implantation. In addition, as for a mask, ion grouting is removed behind. As it is alike (process 2), then is shown in drawing 9 , patterning of the polish recon layer obtained by laser annealing is carried out, and Islands 144a and 144b are formed as a channel pattern.
[0127] Like ion grouting for exfoliation promotion, it can carry out after the 2nd process (channel pattern formation process) as the operation stage (E) besides (A) - (D) mentioned above. In this case, as shown in drawing 31 , it is on island 144a and 144b, and the mask pattern 201 is formed in the channel field in island 144a and 144b, and the part which counters. And the ion for exfoliation promotion, for example, a hydrogen ion, is turned and poured into a detached core 120 in the condition. Thereby, hydrogen does not contain to a channel field and transistor characteristics do not deteriorate. In addition, if it ends like ion grouting for exfoliation promotion, a mask pattern 201 will be removed.
[0128] (Process 3) As shown in drawing 10 , wrap gate dielectric film 148a and 148b is formed for Islands 144a and 144b with a CVD method.
[0129] Like ion grouting for exfoliation promotion, it can carry out after the 3rd process (gate dielectric film) as the operation stage (F) besides (A) - (E) mentioned above. In this case, as shown in drawing 32 , it is on gate-dielectric-film 148a and 148b, and it is desirable to form a mask pattern 202 in the channel field in island 144a and 144b and the part which counters.
[0130] (Process 4) As shown in drawing 11 , the gate electrodes 150a and 150b which consist of polish recon or metal are formed.
[0131] (Process 5) As shown in drawing 12 , the mask layer 170 which consists of polyimide etc. is formed, using gate electrode 150b and the mask layer 170 as a mask, it is a self aryne, for example, the ion implantation of boron (B) is performed. Of this, the p+ layers 172a and 172b are formed.
[0132] Like ion grouting for exfoliation promotion, this boron ion grouting simultaneously can be carried out as that operation stage (G) besides (A) - (F) mentioned above. In this case, the mixed gas of B-2H6(5%)+H2 (95%) is plasma-ized, the boron ion and hydrogen ion which were generated by that cause are accelerated, and it leads to a substrate, without minding a mass spectrograph. If it does so, even if it is the same acceleration voltage, while the boron ion with heavy mass stops at the polycrystalline silicon layer by the side of the upper layer, the hydrogen ion with light mass will be driven in more deeply, and it will reach to a detached core 120.
[0133] In addition, although gate electrode 150b functions as the mask pattern 201 of drawing 31 , or the mask pattern 202 of drawing 32 similarly at this time, according to acceleration voltage, a mask layer can be further prepared on gate electrode 150b.
[0134] (Process 6) As shown in drawing 13 , the mask layer 174 which consists of polyimide etc. is formed, using gate electrode 150a and the mask layer 174 as a mask, it is a self aryne, for example, the ion implantation of Lynn (P) is performed. Of this, the n+ layers 146a and 146b are formed.
[0135] Like ion grouting for exfoliation promotion, this phosphorus ion grouting simultaneously can be carried out as that operation stage (H) besides (A) - (G) mentioned above. Also in this case, the mixed gas of PH3(5%)+H2 (95%) is plasma-ized, the phosphorus ion and hydrogen ion which were generated by that cause are accelerated, and it leads to a substrate, without minding a mass spectrograph. If it does so, even if it is the same acceleration voltage, while the phosphorus ion with heavy mass stops at the polycrystalline silicon layer by the side of the upper layer, the hydrogen ion with light mass will be driven in more deeply, and it will reach to a detached core 120.
[0136] In addition, although gate electrode 150a functions as the mask pattern 201 of drawing 31 , or the mask pattern 202 of drawing 32 similarly in this case, according to acceleration voltage, a mask layer can be further prepared on gate electrode 150a.

[0137] Moreover, although the operation stage like the above-mentioned ion grouting for exfoliation promotion (G) and (H) were as simultaneous as impurity ion grouting to the source in a process 5 and a process 6, and a drain field, they may be separately performed before and behind that.
[0138] (Process 7) As shown in drawing 14 , an interlayer insulation film 154 is formed and Electrodes 152a-152d are alternatively formed after contact hole formation.
[0139] Thus, TFT of the formed CMOS structure corresponds to the transferred layer (thin film device layer) 140 in drawing 2 - drawing 6 . In addition, a protective coat may be formed on an interlayer insulation film 154.
[0140] (Process 8) As shown in drawing 15 , the epoxy resin layer 160 as a glue line is formed on TFT of a CMOS configuration, next TFT is stuck on the imprint object (for example, soda glass substrate) 180 through the epoxy resin layer 160. Then, heat is applied, an epoxy resin is stiffened and the imprint object 180 and TFT are pasted up (junction).
[0141] In addition, the photopolymer resin which is ultraviolet curing mold adhesives is sufficient as a glue line 160. In this case, ultraviolet rays are irradiated from the imprint object [not heat but] 180 side, and a polymer is stiffened.
[0142] (Process 9) As shown in drawing 16 , Xe-Cl excimer laser light is irradiated from the rear face of the translucency substrate 100, for example. This produces and cheats out of exfoliation in the inside of the layer of a detached core 120, and/or an interface.
[0143] (Process 10) A substrate 100 is torn off as shown in drawing 17 .
[0144] (Process 11) Finally etching removes a detached core 120. It means that TFT of a CMOS configuration had been imprinted by the imprint object 180 by this as shown in drawing 18 .
[0145] <The gestalt of the 2nd operation>, next the gestalt of operation of the 2nd of this invention are explained with reference to drawing 33 - drawing 35 . In addition, the gestalt of this 2nd operation imprints twice the transferred layer 140 which consists of thin film device layers, and, in addition to the process of drawing 1 of the gestalt of the 1st operation - drawing 6 , the process of drawing 33 - drawing 35 is added.
[0146] Here, with the gestalt of this 2nd operation, the detached core 120 shown in drawing 2 - drawing 5 is called the 1st detached core. Moreover, with the gestalt of this 2nd operation, the glue line 160 of drawing 3 - drawing 6 is called the 2nd detached core. Furthermore, with the gestalt of this 2nd operation, the imprint object 180 of drawing 3 - drawing 6 is called a primary imprint object. Therefore, according to the gestalt of this 2nd operation, in the phase which the process of drawing 6 ended, it means that the transferred layer 140 had been imprinted by the primary imprint object 180 through the 2nd detached core 160.
[0147] With the gestalt of the 2nd operation here, the quality of the material of the 2nd detached core 160 can use the thing of the same quality of the material not only as thermofusion nature adhesives and water-soluble adhesives but the 1st detached core 120. In order to make easy exfoliation by this 2nd detached core 160 at this time, the ion implantation which was mentioned above and which was explained with the gestalt of the 1st operation can be performed.
[0148] More nearly hereafter, the additional processing of drawing 33 carried out after the process of drawing 6 - drawing 35 explains 1-3.
[0149] As [additional processing is shown in drawing 33 following the process of 1] drawing 6 , the secondary imprint layer 200 is pasted up on the inferior surface of tongue (exposure) of the thin film device layer 140 through a glue line 190.
[0150] As a suitable example of the adhesives which constitute a glue line 190, various hardening mold adhesives, such as photo-curing mold adhesives, such as reaction hardening mold adhesives, heat-curing mold adhesives, and ultraviolet curing mold adhesives, and aversion hardening mold adhesives, are mentioned. As a presentation of adhesives, what kind of thing is sufficient as an epoxy system, an acrylate system, a silicone system, etc., for example. Formation of such a glue line 190 is made for example, by the applying method.
[0151] After applying hardening mold adhesives to the inferior surface of tongue of the transferred layer (thin film device layer) 140 and joining the secondary imprint object 200 further when using said hardening mold adhesives for example, said hardening mold adhesives are stiffened by the hardening approach according to the property of hardening mold adhesives, and

the transferred layer (thin film device layer) 140 and the secondary imprint object 200 are pasted up, and it fixes.
[0152] When adhesives are photo-curing molds, light is preferably irradiated from the outside of the secondary imprint object 200 of light transmission nature. As long as it uses as adhesives photo-curing mold adhesives, such as an ultraviolet curing mold which cannot affect a thin film device layer easily, an optical exposure may be carried out from the primary imprint object 180 side of light transmission nature, or primary [of light transmission nature] and the both sides of the secondary imprint object 180,200.
[0153] In addition, unlike illustration, a glue line 190 may be formed in the secondary imprint object 200 side, and the transferred layer (thin film device layer) 140 may be pasted up on it. In addition, when secondary imprint object 200 the very thing has an adhesion function, for example, formation of a glue line 190 may be omitted.
[0154] although not limited especially as a secondary imprint object 200 -- a substrate (plate) -- especially a transparence substrate is mentioned. In addition, such a substrate may be monotonous or may be a curve plate.
[0155] Moreover, compared with said substrate 100, properties, such as thermal resistance and corrosion resistance, may be inferior in the secondary imprint object 200. It is because the reason forms the transferred layer (thin film device layer) 140 in a substrate 100 side in this invention, and imprints the transferred layer (thin film device layer) 140 on the secondary imprint object 200 after that, so it does not depend on the temperature conditions in the case of formation of the transferred layer (thin film device layer) 140 etc. for the property required of the secondary imprint object 200, especially thermal resistance. This point is the same also about the primary imprint object 180.
[0156] Therefore, when the maximum temperature in the case of formation of the transferred layer 140 is set to Tmax, a glass transition point (Tg) or softening temperature can use the following [Tmax] as a component of primary and the secondary imprint object 180,200. For example, a glass transition point (Tg) or softening temperature can constitute more preferably primary and 800 degrees C or less of 500 degrees C or less of secondary imprint objects 180,200 from an ingredient 320 degrees C or less still more preferably.
[0157] Moreover, although what has a certain amount of ** (reinforcement) as a mechanical property of primary and the secondary imprint object 180,200 is desirable, you may have flexibility and elasticity.
[0158] As a component of such primary and the secondary imprint object 180,200, various synthetic resin or various glass material are mentioned, and various synthetic resin and the usual cheap glass material (low melting point) are desirable especially.
[0159] As synthetic resin, any of thermoplastics and thermosetting resin are sufficient. For example, polyethylene, a polo propylene, an ethylene-pre pyrene copolymer, Polyolefines, such as an ethylene-vinylacetate copolymer (EVA), annular polyolefine, Denaturation polyolefine, a polyvinyl chloride, a polyvinylidene chloride, polystyrene, A polyamide, polyimide, polyamidoimide, a polycarbonate, Polly (4-methyl BENTEN -1), An ionomer, acrylic resin, polymethylmethacrylate, an acrylic-styrene copolymer (AS resin), Butadiene Styrene, a polio copolymer (EVOH), polyethylene terephthalate (PET), Polyester, such as polyp CHIREN terephthalate (PBT) and PURISHI clo hexane terephthalate (PCT), A polyether, a polyether ketone (PEK), a polyether ether ketone (PEEK), Polyether imide, polyacetal (POM), polyphenylene oxide, Denaturation polyphenylene oxide, polyarylate, aromatic polyester (liquid crystal polymer), Polytetrafluoroethylene, polyvinylidene fluoride, other fluorine system resin, A styrene system, a polyolefine system, a polyvinyl chloride system, a polyurethane system, Various thermoplastic elastomer, such as a fluororubber system and a chlorinated polyethylene system, EBOKISHI resin, phenol resin, a urea resin, melamine resin, unsaturated polyester, The copolymer which is mainly concerned with these, a blend object, a polymer alloy, etc. are mentioned, and silicone resin, polyurethane, etc. can be used combining 1 of sorts of these, and two sorts or more (as a layered product for example, more than two-layer).
[0160] As glass material, silicic-acid glass (quartz glass), silicic-acid alkali glass, soda lime glass, potash lime glass, lead (alkali) glass, barium glass, borosilicate glass, etc. are mentioned, for

example. Among these, compared with silicic-acid glass, the melting point is low, and shaping and processing are also comparatively easy the melting point, and, moreover, things other than silicic-acid glass have it, and are desirable. [cheap]
[0161] When using what consisted of synthetic resin as a secondary imprint object 200, while being able to fabricate the large-scale secondary imprint object 200 in one, even if it is complicated configurations, such as what has a curve side and irregularity, it can manufacture easily, and the various advantages that ingredient cost and a manufacturing cost are also cheap can be enjoyed. Therefore, use of synthetic resin is advantageous when manufacturing a large-sized and cheap device (for example, liquid crystal display).
[0162] In addition, the secondary imprint object 200 may constitute some devices like what constitutes the device which became independent in itself like a liquid crystal cell, a color filter and an electrode layer, a dielectric layer, an insulating layer, and a semiconductor device.
[0163] Furthermore, primary and the secondary imprint objects 180,200 may be matter, such as a metal, ceramics, a stone, and wood paper, and may be on the front face of the structures, such as a wall, a column, head lining, and a windowpane, further on the field of the arbitration which constitutes a certain article (superiors of the front-face top of the field top of a clock, and an air-conditioner, and a printed circuit board).
[0164] As [additional processing is shown in 2], next drawing 34 , thermofusion of the thermofusion nature glue line 160 which is the 2nd detached core is heated and carried out. Consequently, since the adhesive strength of the thermofusion nature glue line 160 becomes weaker, it can be made to secede from the primary imprint object 180 by the thin film device layer 140. In addition, this primary imprint object 180 can be repeated and reused by removing the thermofusion nature adhesives adhering to the primary imprint object 180.
[0165] What is necessary is just to dip preferably the field which contains the 2nd detached core 160 at least in pure water that what is necessary is just to make water contact, when the water-soluble adhesives mentioned above as the 2nd detached core 160 are used. What is necessary is just to contact the field which contains the 2nd detached core 160 at least to an organic solvent, when the organic solvent melting nature adhesives mentioned above as the 2nd detached core 160 are used. the field which contains the 2nd detached core 160 at least when the adhesives which present an exfoliation operation by heating or UV irradiation mentioned above as the 2nd detached core 160 are used — other layers — minding — heating — or what is necessary is just to carry out UV irradiation Moreover, when an ablation layer is used like the 1st detached core 120 as the 2nd detached core, the 2nd detached core 160 is made to produce an exfoliation phenomenon by optical exposure. That exfoliation is promoted by the effectiveness of impregnation ion at this time.
[0166] As [additional processing is shown in drawing 35 by removing the 2nd detached core 160 which adhered to the front face of the thin film device layer 140 at the 3] last, the thin film device layer 140 imprinted by the secondary imprint object 200 can be obtained. Here, the laminating relation of the thin film device layer 140 to this secondary imprint object 200 becomes the same as the laminating relation of the thin film device layer 140 to the original substrate 100, as shown in drawing 2 .
[0167] The imprint to the secondary imprint object 200 of the transferred layer (thin film device layer) 140 is completed through each above process. Then, conductive layers, such as removal of SiO2 film which adjoins the transferred layer (thin film device layer) 140, and wiring of a up to [the transferred layer 140], formation of a desired protective coat, etc. can also be performed.
[0168] With the gestalt of the 2nd operation, transferred layer (thin film device layer) 140 the very thing which is an exfoliated object is not exfoliated directly. In order to dissociate in the 1st detached core 120 and the 2nd detached core 160 and to imprint on the secondary imprint object 200, Irrespective of the property of a dissociated object (transferred layer 140), conditions, etc., easily and certainly, it can imprint to homogeneity, there is also no damage to the dissociated object (transferred layer 140) in accordance with separation actuation, and the high dependability of the transferred layer 140 can be maintained.
[0169] If the technique explained with the <gestalt of the 3rd operation> above-mentioned 1st and the gestalt of the 2nd operation is used, the microcomputer constituted using the thin film

device as shown in drawing 19 (a), for example can be formed on a desired substrate.
[0170] In drawing 19 (a), the solar battery 340 possessing the PIN junction of an amorphous silicon for supplying the supply voltage of CPU300, RAM320 and the I/O circuits 360 where the thin film device was used and the circuit was constituted, and these circuits is carried on the flexible substrate 182 which consists of plastics etc.
[0171] Since the microcomputer of drawing 19 (a) is formed on the flexible substrate, as shown in drawing 19 (b), since it is lightweight, it has strongly the description that it is strong also to fall in bending.
[0172] The gestalt of <gestalt of the 4th operation> book operation explains the example of the manufacture process in the case of creating the liquid crystal display of the active-matrix mold using a active-matrix substrate as shown in drawing 20 and drawing 21 using the imprint technique of an above-mentioned thin film device.
[0173] (Configuration of a liquid crystal display) As shown in drawing 20 , the liquid crystal display of a active-matrix mold possesses the sources 400 of the illumination light, such as a back light, a polarizing plate 420, the active-matrix substrate 440, liquid crystal 460, the opposite substrate 480, and a polarizing plate 500.
[0174] In addition, if it constitutes as a reflective mold liquid crystal panel which replaced with the source 400 of the illumination light, and adopted the reflecting plate when using a flexible substrate like plastic film for the active-matrix substrate 440 and the opposite substrate 480 of this invention, there is flexibility and a lightweight active matrix liquid crystal panel strong against an impact and can be realized. In addition, when a pixel electrode is formed with a metal, a reflecting plate and a polarizing plate 420 become unnecessary.
[0175] The active-matrix substrate 440 used with the gestalt of this operation arranges TFT in the pixel section 442, and is a driver built-in active-matrix substrate in which the driver circuit (a scanning-line driver and data-line driver) 444 was carried further.
[0176] The sectional view of the important section of this active matrix liquid crystal display is shown in drawing 21 , and the circuitry of the important section of a liquid crystal display is shown in drawing 22 .
[0177] As shown in drawing 22 , the gate is connected to the gate line G1, one side of a source drain is connected to the data line D1, and the pixel section 442 contains TFT (M1) by which another side of a source drain was connected to liquid crystal 460, and liquid crystal 460.
[0178] Moreover, the driver section 444 is constituted including TFT (M2) formed of the same process as TFT (M1) of the pixel section.
[0179] As shown in the left-hand side of drawing 21 , TFT (M1) in the pixel section 442 is constituted including the source drain layers 1100a and 1100b, channel 1100e, gate-dielectric-film 1200a, gate electrode 1300a, an insulator layer 1500, and the source drain electrodes 1400a and 1400b.
[0180] In addition, a reference number 1700 is a pixel electrode and a reference number 1702 shows the field (electrical-potential-difference impression field to liquid crystal) where the pixel electrode 1700 impresses an electrical potential difference to liquid crystal 460. The orientation film is omitted among drawing. The pixel electrode 1700 is constituted by metals (in the case of the liquid crystal panel of a reflective mold), such as ITO (in the case of the liquid crystal panel of a light transmission mold), or aluminum. Moreover, in drawing 21 , in the electrical-potential-difference impression field 1702 to liquid crystal, although the substrate insulator layer 1000 under the pixel electrode 1700 (interlayer) is removed completely, it is not necessarily limited to this, and since the substrate insulator layer (interlayer) 1000 is thin, when not becoming the hindrance of the electrical-potential-difference impression to liquid crystal, you may leave.
[0181] Moreover, as shown in the right-hand side of drawing 21 , TFT (M2) which constitutes the driver section 444 is constituted including the source, the drain layers 1100c and 1100d, channel 1100f, gate-dielectric-film 1200b, gate electrode 1300b, an insulator layer 1500, and the source drain electrodes 1400c and 1400d.
[0182] In addition, in drawing 21 , a reference number 480 is for example, an opposite substrate (for example, soda glass substrate), and a reference number 482 is a common electrode. Moreover, a reference number 1000 is SiO2 film, a reference number 1600 is an interlayer

insulation film (for example, SiO2 film), and a reference number 1800 is a glue line. Moreover, a reference number 1900 is a substrate (imprint object) which consists for example, of a soda glass substrate.
[0183] (Manufacture process of a liquid crystal display) The manufacture process of the liquid crystal display of drawing 21 is hereafter explained with reference to drawing 23 – drawing 27 .
[0184] First, it forms through the same manufacture process as drawing 8 – drawing 18 on the substrate (for example, quartz substrate) 3000 which it is reliable in TFT (M1, M2) like drawing 23 , and penetrates laser light, and a protective coat 1600 is constituted. In addition, in drawing 23 , a reference number 3100 is a detached core (laser absorption layer) into which the ion for exfoliation promotion is poured. Moreover, in drawing 23 , both TFT(s) (M1, M2) are taken as MOSFET of n mold. However, it is good also as not the thing limited to this but MOSFET of p mold, and CMOS structure.
[0185] Next, as shown in drawing 24 , a protective coat 1600 and the substrate insulator layer 1000 are etched alternatively, and openings 4000 and 4200 are formed alternatively. These two openings are formed in coincidence using a common etching process. In addition, although the substrate insulator layer (interlayer) 1000 is completely removed in opening 4200 in drawing 24 , it is not necessarily limited to this, and since the substrate insulator layer (interlayer) 1000 is thin, when not becoming the hindrance of the electrical-potential-difference impression to liquid crystal, you may leave.
[0186] Next, as shown in drawing 25 , the pixel electrode 1700 which consists of metals, such as ITO film or aluminum, is formed. In using the ITO film, it becomes the liquid crystal panel of a transparency mold, and in using metals, such as aluminum, it becomes the liquid crystal panel of a reflective mold. Next, as shown in drawing 26 , a substrate 1900 is joined through a glue line 1800 (adhesion).
[0187] Next, excimer laser light is irradiated from the rear face of a substrate 3000, the operation by the ion for exfoliation promotion is also used, and a detached core 120 is made to produce an exfoliation phenomenon, as shown in drawing 26 . Then, a substrate 3000 is torn off. Since the force like ** is not required for tearing off at this time, a mechanical damage does not arise in TFT.
[0188] Next, a detached core (laser absorption layer) 3100 is removed. Thereby, the active-matrix substrate 440 as shown in drawing 27 is completed. It has exposed and the electric connection with liquid crystal is possible for the base (field of a reference number 1702) of the pixel electrode 1700. Then, the orientation film is formed in the front face of the insulator layer (interlayers, such as SiO2) 1000 of the active-matrix substrate 440, and pixel electrode 1702 front face, and orientation processing is performed. The orientation film is omitted in drawing 27 .

[0189] And the pixel electrode 1709 and the common electrode which counters are further formed in the front face, the opposite substrate 480 and the active MATORIKU substrate 440 of drawing 21 with which orientation processing of the front face was carried out are closed with a sealing agent (sealant), liquid crystal is enclosed among both substrates, and a liquid crystal display as shown in drawing 21 is completed.
[0190] The gestalt of operation of the 5th of this invention is shown in <gestalt of the 5th operation> drawing 28 .
[0191] With the gestalt of this operation, multiple-times activation of the imprint approach of an above-mentioned thin film device is carried out, on a larger substrate (imprint object) than the substrate of an imprinting agency, two or more patterns containing a thin film device are imprinted, and, finally a large-scale active-matrix substrate is formed.
[0192] That is, on the big substrate 7000, the imprint of multiple times is performed and the pixel sections 7100a-7100P are formed. TFT and wiring are formed in the pixel section as surrounded and shown to the drawing 28 bottom by the alternate long and short dash line. In drawing 28 , a reference number 7210 is the scanning line, a reference number 7200 is a signal line and a reference number 7230 is [a reference number 7220 is a gate electrode and] a pixel electrode.
[0193] The large-scale active-matrix substrate carrying a reliable thin film device can be created by repeating and using a reliable substrate or carrying out multiple-times activation of the

imprint of a thin film pattern using two or more 1st substrates.
[0194] The gestalt of operation of the 6th of <gestalt of the 6th operation> this invention is shown in drawing 29 .
[0195] The description of the gestalt of this operation is imprinting two or more patterns containing the thin film device (that is, thin film device with which minimum line width's differs) with which multiple-times activation of the imprint approach of an above-mentioned thin film device is carried out, and the design Ruhr's (that is, design rule's when carrying out a pattern design's) differs on a bigger substrate than the substrate top of an imprinting agency.
[0196] In drawing 29 , the driver circuit (8000-8032) created in the more detailed manufacture process rather than the pixel section (7100a-7100p) is created around the substrate 6000 by the imprint of multiple times in the active-matrix substrate of driver loading.
[0197] Since the shift register which constitutes a driver circuit carries out actuation of a logic level to the bottom of a low battery, rather than Pixel TFT, pressure-proofing may be low, and as it is therefore set to TFT more detailed than Pixel TFT, high integration can be attained.
[0198] According to the gestalt of this operation, two or more circuits where design Ruhr level differs (that is, manufacture processes differ) are realizable on one substrate. In addition, since high pressure-proofing is the need like Pixel TFT, a sampling means (thin film transistor M2 of drawing 22) to sample a data signal by control of a shift register may be formed in the same process as Pixel TFT / same design Ruhr.

[Translation done.]

EXAMPLE

[Example] Next, the concrete example of this invention is explained.
[0200] (Example 1) The quartz substrate (1630 degrees C, a strain point: softening temperature : 1070 degrees C, permeability of excimer laser : about 100%) with a 50mm[50mm by] x thickness of 1.1mm was prepared, and the amorphous silicon (a-Si) film was formed in one side of this quartz substrate as a detached core (laser beam absorption layer) with the low voltage CVD method (Si2 H6 gas, 425 degrees C). The thickness of a detached core was 100nm.
[0201] Next, it is SiO2 as an interlayer on a detached core. The film was formed with the ECR-CVD method (SiH4+O2 gas, 100 degrees C). An interlayer's thickness was 200nm.
[0202] Next, the amorphous silicon film of 50nm of thickness was formed as a transferred layer on the interlayer with the low voltage CVD method (Si2 H6 gas, 425 degrees C), a laser beam (wavelength of 308nm) is irradiated, this amorphous silicon film was crystallized, and it considered as the polish recon film. Then, to this polish recon film, predetermined pattern NINGU was given and the field used as the source drain channel of a thin film transistor was formed. then, a TEOS-CVD method (SiH4+O2 gas) — 1200nm gate dielectric film SiO2 after forming, form a gate electrode (structure where laminating formation of the refractory metals, such as Mo, was carried out at polish recon), on gate dielectric film, and it carries out an ion implantation, using a gate electrode as a mask — self align ----like (selfer line) — the source drain field was formed and the thin film transistor was formed. At this time, the hydrogen ion was poured into coincidence at the detached core. Then, the electrode connected to a source drain field and wiring, and wiring which leads to a gate electrode are formed if needed. Although aluminum is used for these electrodes and wiring, it is not limited to this. Moreover, when worrying about melting of aluminum by the laser radiation of a back process, a high-melting metal (what is not fused by the laser radiation of a back process) may be used rather than aluminum.
[0203] Next, ultraviolet curing mold adhesives were applied on said thin film transistor (thickness: 100 micrometers), further, after joining a transparent large-sized glass substrate (soda glass, softening-temperature:740 degree C, a strain point: 511 degrees C) with a 300mm[200mm by] x thickness of 1.1mm to the paint film as an imprint object, ultraviolet rays were irradiated from the glass substrate side, adhesives were stiffened, and adhesion immobilization of these was carried out.
[0204] Next, Xe-Cl excimer laser (wavelength: 308nm) was irradiated from the quartz substrate side, and the detached core was made to produce exfoliation (exfoliation in a layer, and interfacial peeling) by carrying out the beam scan shown after drawing 31 . The irradiated energy density of Xe-Cl excimer laser was 250 mJ/cm2, and irradiation time was 20ns. In addition, the exposure of excimer laser had a spot beam exposure and the Rhine beam exposure, and when it was a spot beam exposure, the spot exposure was carried out to the predetermined unit field (for example, 8mmx8mm), and it irradiated this spot exposure, carrying out a beam scan so that the exposure field of each time may not lap (it does not lap all around like). Moreover, in the Rhine beam exposure, it irradiated, carrying out the beam scan of the predetermined unit field (for example, 378mmx0.1mm and 378mmx0.3mm (field where, as for these, 90% or more of energy is obtained)) similarly, so that the exposure field of each time may not lap.
[0205] Then, the quartz substrate and the glass substrate (imprint object) were torn off in the

detached core, and the thin film transistor and interlayer who were formed on the quartz substrate were imprinted to the glass substrate side.
[0206] Then, etching, washing, or those combination removed the detached core adhering to the front face of the middle class by the side of a glass substrate. Moreover, processing with the same said of a quartz substrate was performed, and the reuse was presented.
[0207] In addition, if the glass substrate used as an imprint object is a bigger substrate than a quartz substrate, the imprint to a glass substrate from a quartz substrate like this example can be repeatedly carried out to a superficially different field, and many thin film transistors can be formed on a glass substrate from the number of the thin film transistors which can be formed in a quartz substrate. Furthermore, on a glass substrate, a laminating can be carried out repeatedly and more thin film transistors can be formed similarly.
[0208] (Example 2) a detached core — a detached core formation process — H (hydrogen) — 20at(s)% — the thin film transistor was imprinted like the example 1 except having considered as the amorphous silicon film to contain.
[0209] In addition, adjustment of the amount of H in the amorphous silicon film was performed by setting up suitably the conditions at the time of membrane formation by the low voltage CVD method.
[0210] (Example 3) The thin film transistor was imprinted like the example 1 except having used the detached core as the ceramic thin film (presentation-bTiO3, thickness: 200nm) formed with the sol-gel method with the spin coat.
[0211] (Example 4) The thin film transistor was imprinted like the example 1 except having used the detached core as the ceramic thin film (presentation: BaTiO3, thickness:400nm) formed by sputtering.
[0212] (Example 5) The thin film transistor was imprinted like the example 1 except having used the detached core as the ceramic thin film (presentation :P b (Zr Ti)O3 (PZT) and thickness: 50nm) formed by the laser-ablation method.
[0213] (Example 6) The thin film transistor was imprinted like the example 1 except having used the detached core as the polyimide film (thickness: 200nm) formed with the spin coat.
[0214] (Example 7) The thin film transistor was imprinted like the example 1 except having used the detached core as the polyphenylene sulfide film (thickness: 200nm) formed with the spin coat.
[0215] (Example 8) The thin film transistor was imprinted like the example 1 except having used the detached core as aluminum layer (thickness: 300nm) formed by sputtering.
[0216] (Example 9) As an exposure light, the thin film transistor was imprinted like the example 2 except having used Kr-F excimer laser (wavelength: 248nm). In addition, the energy density of the irradiated laser was 250 mJ/cm2, and irradiation time was 20ns.
[0217] (Example 10) As an exposure light, the thin film transistor was imprinted like the example 2 except having used Nd-YAIG laser (wavelength: 1068nm). In addition, the energy density of the irradiated laser was 400 mJ/cm2, and irradiation time was 20ns.
[0218] (Example 11) The thin film transistor was imprinted like the example 1 except having considered as the thin film transistor of the polish recon film (80nm of thickness) by elevated-temperature process 1000 degree C as a transferred layer.
[0219] (Example 12) As an imprint object, the thin film transistor was imprinted like the example 1 except having used the transparence substrate made from a polycarbonate (glass transition point: 130 degrees C).
[0220] (Example 13) As an imprint object, the thin film transistor was imprinted like the example 2 except having used the transparence substrate made of an AS resin (glass transition point: 70-90 degrees C).
[0221] (Example 14) As an imprint object, the thin film transistor was imprinted like the example 3 except having used the transparence substrate made from polymethylmethacrylate (glass transition point: 70-90 degrees C).
[0222] (Example 15) As an imprint object, the thin film transistor was imprinted like the example 5 except having used the transparence substrate made from polyethylene terephthalate (glass transition point: 67 degrees C).

[0223] (Example 16) As an imprint object, the thin film transistor was imprinted like the example 6 except having used the transparence substrate made from high density polyethylene (glass transition point: 77-90 degrees C).
(Example 17) As an imprint object, the thin film transistor was imprinted like the example 9 except having used the transparence substrate made from a polyamide (glass transition point: 145 degrees C).
[0224] (Example 18) As an imprint object, the thin film transistor was imprinted like the example 10 except having used the transparence substrate made of an epoxy resin (glass transition point: 120 degrees C).
[0225] (Example 19) As an imprint object, the thin film transistor was imprinted like the example 11 except having used the transparence substrate made from polymethylmethacrylate (glass transition point: 70-90 degrees C).
[0226] About examples 1-19, when the condition of the imprinted thin film transistor was guessed the ** view under the naked eye and the microscope, respectively, all had neither a defect nor nonuniformity and the imprint was made by homogeneity.
[0227] As stated above, when using the imprint technique of this invention, it was able to become possible to imprint a thin film device (transferred layer) to various imprint objects, especially exfoliation of a substrate required for an imprint was able to be performed reasonable, without acting too much force. or [that a thin film cannot be formed directly by this] -- or it can be formed by imprint also to what consisted of an ingredient unsuitable for forming, an ingredient with easy shaping, a cheap ingredient, etc., the large-sized body which is hard to move.
[0228] That in which properties, such as thermal resistance and corrosion resistance, are inferior compared with various synthetic resin or a substrate ingredient like glass material with the low melting point can be used especially for an imprint object. therefore -- for example, it can face manufacturing the liquid crystal display in which the thin film transistor (especially poly-Si TFT) was formed on the transparence substrate, and a large-sized and cheap liquid crystal display can be easily manufactured now as an imprint object as a substrate using the quartz-glass substrate which is excellent in thermal resistance by using a transparence substrate of the ingredient which it is cheap and processing tends to carry out like glass material with low various synthetic resin and melting point. Such an advantage is the same also about manufacture of not only a liquid crystal display but other devices.
[0229] Moreover, although the above advantages are enjoyed, since a transferred layer like a functional thin film can be formed to a heat-resistant high substrate like a reliable substrate, especially a quartz-glass substrate and patterning can be carried out further, a reliable functional thin film can be formed on an imprint object irrespective of the material property of an imprint object.
[0230] Moreover, although such a reliable substrate is expensive, it is also possible to reuse it and, therefore, a manufacturing cost is also reduced.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the 1st process in the gestalt of implementation of the 1st of the imprint approach of the thin film device of this invention.
[Drawing 2] It is the sectional view showing the 2nd process in the gestalt of implementation of the 1st of the imprint approach of the thin film device of this invention.
[Drawing 3] It is the sectional view showing the 3rd process in the gestalt of implementation of the 1st of the imprint approach of the thin film device of this invention.
[Drawing 4] It is the sectional view showing the 4th process in the gestalt of implementation of the 1st of the imprint approach of the thin film device of this invention.
[Drawing 5] It is the sectional view showing the 5th process in the gestalt of implementation of the 1st of the imprint approach of the thin film device of this invention.
[Drawing 6] It is the sectional view showing the 6th process in the gestalt of implementation of the 1st of the imprint approach of the thin film device of this invention.
[Drawing 7] It is drawing showing change of the permeability to the wavelength of the laser light of the 1st substrate (substrate 100 of drawing 1).
[Drawing 8] It is the sectional view showing the 1st process for forming the thin film device of drawing 2 .
[Drawing 9] It is the sectional view showing the 2nd process for forming the thin film device of drawing 2 .
[Drawing 10] It is the sectional view showing the 3rd process for forming the thin film device of drawing 2 .
[Drawing 11] It is the sectional view showing the 4th process for forming the thin film device of drawing 2 .
[Drawing 12] It is the sectional view showing the 5th process for forming the thin film device of drawing 2 .
[Drawing 13] It is the sectional view showing the 6th process for forming the thin film device of drawing 2 .
[Drawing 14] It is the sectional view showing the 7th process for forming the thin film device of drawing 2 .
[Drawing 15] It is a sectional view to show the process shown in drawing 3 in a detail.
[Drawing 16] It is a sectional view to show the detail of the process shown in drawing 4 .
[Drawing 17] It is a sectional view to show the detail of the process shown in drawing 5 .
[Drawing 18] It is a sectional view to show the detail of the process shown in drawing 6 .
[Drawing 19] (a) and (b) are both the perspective views of the microcomputer manufactured using this invention.
[Drawing 20] It is drawing for explaining the configuration of a liquid crystal display.
[Drawing 21] It is drawing showing the cross-section structure of the important section of a liquid crystal display.
[Drawing 22] It is drawing for explaining the configuration of the important section of a liquid crystal display.
[Drawing 23] It is the sectional view of the device in which the 1st process of the manufacture

approach of the active-matrix substrate using this invention is shown.
[Drawing 24] It is the sectional view of the device in which the 2nd process of the manufacture approach of the active-matrix substrate using this invention is shown.
[Drawing 25] It is the sectional view of the device in which the 3rd process of the manufacture approach of the active-matrix substrate using this invention is shown.
[Drawing 26] It is the sectional view of the device in which the 4th process of the manufacture approach of the active-matrix substrate using this invention is shown.
[Drawing 27] It is the sectional view of the device in which the 5th process of the manufacture approach of the active-matrix substrate using this invention is shown.
[Drawing 28] It is drawing of a ****** sake about other examples of the imprint approach of the thin film device of this invention.
[Drawing 29] It is drawing of a ****** sake about the example of further others of the imprint approach of the thin film device of this invention.
[Drawing 30] It is drawing of a ****** sake about the modification of the imprint approach of the thin film device of this invention.
[Drawing 31] It is the sectional view showing the impregnation process of the ion for exfoliation promotion carried out after the process of drawing 9 .
[Drawing 32] It is the sectional view showing the impregnation process of the ion for exfoliation promotion carried out after the process of drawing 10 .
[Drawing 33] The additional processing at the time of the 2 times imprint performed by continuing at the process of drawing 6 is the outline sectional view showing 1.
[Drawing 34] The additional processing at the time of the 2 times imprint performed by continuing at the process of drawing 33 is the outline sectional view showing 2.
[Drawing 35] The additional processing at the time of the 2 times imprint performed by continuing at the process of drawing 34 is the outline sectional view showing 3.
[Description of Notations]
100 Substrate
120 Detached Core
140 Thin Film Device Layer
160 Glue Line
180 Imprint Object

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（Ａ）　(11)特許出願公開番号
特開平11－312811
(43)公開日　平成11年(1999)11月９日

(51)Int.Cl.⁶	識別記号	ＦＩ	
ＨＯ１Ｌ　29/786		ＨＯ１Ｌ　29/78	６２７Ｄ
21/336		ＧＯ２Ｆ　1/136	５００
ＧＯ２Ｆ　1/136	５００	ＨＯ１Ｌ　29/78	６１６Ｍ
			６２７Ｇ

審査請求　未請求　請求項の数18　ＦＤ　（全 23 頁）

(21)出願番号　特願平10－296216
(22)出願日　平成10年(1998)10月２日
(31)優先権主張番号　特願平10－60594
(32)優先日　平10(1998)２月25日
(33)優先権主張国　日本（ＪＰ）

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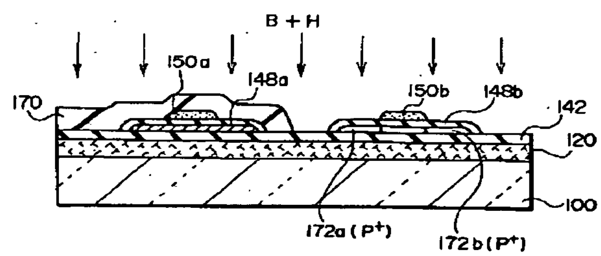
(54)【発明の名称】　薄膜デバイスの剥離方法、薄膜デバイスの転写方法、薄膜デバイス、アクティブマトリクス基板および液晶表示装置

(57)【要約】
【課題】　基板上に形成された薄膜デバイスを、その基板から容易に剥離させることのできる方法を提供すること。
【解決手段】　基板（１００）上に分離層（１２０）を設けておき、その基板上にＴＦＴ等の薄膜デバイス（１４０）を形成する。その薄膜デバイス（１４０）の形成プロセス途中にて、剥離促進用イオン例えば水素イオンを、分離層（１２０）に注入する。薄膜デバイス（１４０）の形成後、好ましくは接着層（１６０）を介てて薄膜デバイス（１４０）を転写体（１８０）に接合した後に、基板側からレーザー光を照射する。これによって分離層（１２０）では、剥離促進用イオンの作用をも利用して剥離を生じせしめる。その薄膜デバイス（１４０）を基板（１００）より離脱させる。これにより、どのような基板にでも所望の薄膜デバイスを転写できる。



【特許請求の範囲】
【請求項１】　基板上に分離層を形成する第１工程と、
前記分離層上に薄膜デバイスを形成する第２工程と、
前記分離層の層内および／または界面において剥離現象を生じさせて、前記基板を前記分離層から剥離させる第３工程と、
を有する薄膜デバイスの剥離方法であって、
前記第３工程の前に、前記分離層にイオンを注入するイオン注入工程を設けたことを特徴とする薄膜デバイスの剥離方法。
【請求項２】　請求項１において、
前記３工程では、前記分離層に注入された前記イオンを気体化させる工程を含むことを特徴とする薄膜デバイスの剥離方法。
【請求項３】　請求項２において、
前記第３工程は、記分離層に光照射する工程を含むことを特徴とする薄膜デバイスの剥離方法。
【請求項４】　請求項１乃至３のいずれかにおいて、
前記イオン注入工程では、前記イオンにより前記分離層を構成する原子または分子の結合を切断して、前記分離層に予めダメージを与えておくことを特徴とする薄膜デバイスの剥離方法。
【請求項５】　請求項１乃至４のいずれかにおいて、
前記イオン注入工程では、前記イオンにより前記分離層の特性を変化させて、前記分離層と前記基板との密着性を予め弱めておくことを特徴とする薄膜デバイスの剥離方法。
【請求項６】　請求項１乃至５のいずれかにおいて、
前記第２工程は、薄膜トランジスタを形成するための薄膜トランジスタ形成工程を有し、
前記薄膜トランジスタ形成工程はチャネル層形成工程を含み、
前記イオン注入工程は、前記チャネル層形成工程の後に実施されることを特徴とする薄膜デバイスの剥離方法。
【請求項７】　請求項６において、
前記薄膜トランジスタ形成工程は、前記チャネル層形成工程後にチャネルパターン形成工程を含み、
前記イオン注入工程は、前記チャネルパターン形成工程の後に実施されることを特徴とする薄膜デバイスの剥離方法。
【請求項８】　請求項６または７において、
前記イオン注入工程は、前記チャネル層のうちチャネル領域となる領域上にマスクを形成して実施されることを特徴とする薄膜デバイスの剥離方法。
【請求項９】　請求項７において、
前記薄膜トランジスタ形成工程は、前記チャネルパターン形成工程後に、該チャネルパターン上にゲート絶縁膜を形成する工程と、該ゲート絶縁膜上であって前記チャネル領域と対向する領域にゲート電極を形成する工程と、を含み、

前記ゲート電極をマスクとして前記イオン注入工程を実施することを特徴とする薄膜デバイスの剥離方法。
【請求項１０】　請求項８または９において、
前記イオン注入工程は、前記チャネルパターン内のソース領域及びドレイン領域の少なくとも一方に打ち込まれる不純物イオンと、それよりも質量が軽く前記分離層に打ち込まれる前記イオンとを、同時に注入することを特徴とする薄膜デバイスの剥離方法。
【請求項１１】　請求項６において、
前記薄膜トランジスタ形成工程は、前記チャネル層としてアモルファスシリコン層を形成する工程と、その後前記アモルファスシリコン層をレーザアニールして結晶化させる結晶化工程と、を含み、
前記イオン注入工程は、前記結晶化工程の前に実施されることを特徴とする薄膜デバイスの剥離方法。
【請求項１２】　請求項１乃至１１のいずれかにおいて、
前記イオンは水素イオンであることを特徴とする薄膜デバイスの剥離方法。
【請求項１３】　請求項１２において、
前記イオン注入工程後に実施される工程のプロセス温度を、３５０℃未満としたことを特徴とする薄膜デバイスの剥離方法。
【請求項１４】　請求項１乃至１３のいずれかに載の剥離方法を用いて前記基板より剥離されて成る薄膜デバイス。
【請求項１５】　マトリクス状に配置された薄膜トランジスタと、その薄膜トランジスタの一端に接続された画素電極とを含んで画素部が構成されるアクティブマトリクス基板であって、
請求項６乃至１３のいずれかに記載の方法を用いて前記画素部の薄膜トランジスタを転写することにより製造されたアクティブマトリクス基板。
【請求項１６】　請求項１５に記載のアクティブマトリクス基板を用いて製造された液晶表示装置。
【請求項１７】　基板上に第１分離層を形成する第１工程と、
前記第１分離層上に薄膜デバイスを含む被転写層を形成する第２工程と、
前記被転写層上に水溶性または有機溶剤溶融性接着剤から成る第２分離層を形成する第３工程と、
前記第２分離層上に一次転写体を接合する第４工程と、
前記第１分離層を境にして、前記被転写層より前記基板を除去する第５工程と、
前記被転写層の下面に二次転写体を接合する第６工程と、
前記第２分離層を水または有機溶剤と接触させて、前記第２分離層を境にして、前記被転写層より前記一次転写体を除去する第７工程と、
を有し、前記薄膜デバイスを含む前記被転写層を二次転

写体に転写することを特徴とする薄膜デバイスの転写方法。

【請求項１８】　基板上に第１分離層を形成する第１工程と、
前記第１分離層上に薄膜デバイスを含む被転写層を形成する第２工程と、
前記被転写層上に加熱または紫外線照射により剥離作用を有する接着剤から成る第２分離層を形成する第３工程と、
前記第２分離層上に一次転写体を接合する第４工程と、
前記第１分離層を境にして、前記被転写層より前記基板を除去する第５工程と、
前記被転写層の下面に二次転写体を接合する第６工程と、
前記第２分離層を加熱または紫外線照射して、前記第２分離層を境にして、前記被転写層より前記一次転写体を除去する第７工程と、
を有し、前記薄膜デバイスを含む前記被転写層を二次転写体に転写することを特徴とする薄膜デバイスの転写方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、薄膜デバイスの剥離方法、薄膜デバイスの転写方法、薄膜デバイス、アクティブマトリクス基板および液晶表示装置に関する。

【０００２】

【背景技術】例えば、薄膜トランジスタ（ＴＦＴ）を用いた液晶ディスプレイを製造するに際しては、基板上に薄膜トランジスタをＣＶＤ等により形成する工程を経る。薄膜トランジスタを基板上に形成する工程は高温処理を伴うため、基板は耐熱性に優れる材質のもの、すなわち、軟化点および融点が高いものを使用する必要がある。そのため、現在では、１０００℃程度の温度に耐える基板としては石英ガラスが使用され、５００℃前後の温度に耐える基板としては耐熱ガラスが使用されている。

【０００３】上述のように、薄膜デバイスを搭載する基板は、それらの薄膜デバイスを製造するための条件を満足するものでなければならない。つまり、使用する基板は、搭載されるデバイスの製造条件を必ず満たすように決定される。

【０００４】しかし、ＴＦＴ等の薄膜デバイスを搭載した基板が完成した後の段階のみに着目すると、上述の「基板」が必ずしも好ましくないこともある。

【０００５】例えば、上述のように、高温処理を伴う製造プロセスを経る場合には、石英基板や耐熱ガラス基板等が用いられるが、これらは非常に高価であり、したがって製品価格の上昇を招く。

【０００６】また、ガラス基板は重く、割れやすいという性質をもつ。パームトップコンピュータや携帯電話機等の携帯用電子機器に使用される液晶ディスプレイでは、可能な限り安価で、軽くて、多少の変形にも耐え、かつ落としても壊れにくいのが望ましいが、現実には、ガラス基板は重く、変形に弱く、かつ落下による破壊の恐れがあるのが普通である。

【０００７】つまり、製造条件からくる制約と製品に要求される好ましい特性との間に溝があり、これら双方の条件や特性を満足させることは極めて困難であった。

【０００８】そこで本願出願人は、薄膜デバイスを従来のプロセスにて第１の基板上に形成した後に、この薄膜デバイスを第１の基板から剥離して、第２の基板に転写させる技術を提案している（特願平８－２２５６４３号）。このために、第１の基板と被転写層である薄膜デバイスとの間に、分離層を形成している。この分離層に例えば光を照射することで、第１の基板から被転写層である薄膜デバイスを剥離させ、この被転写層を第２の基板側に転写させている。

【０００９】

【発明が解決しようとする課題】本発明者の実験によれば、第１基板から薄膜デバイスを剥離させる際に、分離層に例えば光を照射しただけでは十分に分離層にて剥離現象が生じない場合があることが発見された。

【００１０】そして、本発明者の鋭意研究によれば、この剥離現象が生じやすいか否かは、分離層の性質に依存することが判明した。

【００１１】さらに、被転写層を製造する時に用いた第１の基板に対する被転写層の積層関係と、その被転写層の転写先である第２の基板に対する被転写層の積層関係とは、互いに異なってしまうという課題があった。

【００１２】そこで、本発明は、分離層に剥離に剥離現象を生じさせる工程の前に、分離層が剥離し易い状態になることを補償して、基板から薄膜デバイスを容易に剥離させるようにした薄膜デバイスの剥離方法並びにそれを用いて製造される薄膜デバイス、アクティブマトリクス基板および液晶表示装置を提供することにある。

【００１３】本発明の他の目的は、被転写層の製造時に用いた基板に対する被転写層の積層関係と、その被転写層の転写先である転写体に対する被転写層の積層関係とを一致させることができる薄膜デバイスの転写方法を提供することにある。

【００１４】

【課題を解決するための手段】請求項１に記載の発明は、基板上に分離層を形成する第１工程と、前記分離層上に薄膜デバイスを形成する第２工程と、前記分離層の層内および／または界面において剥離現象を生じさせて、前記基板を前記分離層から剥離させる第３工程と、を有する薄膜デバイスの剥離方法において、前記第３工程の前に、前記分離層にイオンを注入するイオン注入工程を設けたことを特徴とする。

【００１５】デバイス製造における信頼性が高い例えば

石英基板などの基板上に、例えば、光を吸収する特性をもつ分離層を設けておき、その基板上にＴＦＴ等の薄膜デバイスを形成する。好ましくは次に、例えば接着層を介して薄膜デバイスを所望の転写体に接合しておく。その後に分離層に例えば光を照射し、その分離層において剥離現象を生じせしめる。これにより、例えば基板に力を加えることで、薄膜デバイスを基板から剥離させることができる。

【００１６】このとき、剥離工程の前にイオンを分離層に注入しておくことで、剥離工程における分離層の剥離現象が顕著となり、薄膜デバイスを確実に基板より剥離させることができる。

【００１７】ここで、イオンを分離層に予め注入することで、請求項２～５のいずれかに定義された作用がなされて、分離層の剥離現象が顕著となる。

【００１８】請求項２によれば、前記３工程に、前記分離層に注入された前記イオンが気体化される工程が含まれる。分離層内のイオンが気体化されると、分離層内に内圧が生じてその剥離現象が促進される。

【００１９】この場合、請求項３に示すように、分離層に光を照射し、その光によって剥離用イオンを気体化させることができる。このとき、基板の裏面側より光照射すると、薄膜デバイス層に光入射される光量を低減することができ、その特性の劣化を防止できる。

【００２０】請求項４によれば、前記イオン注入工程では、前記イオンにより前記分離層を構成する原子または分子の結合を切断して、前記分離層に予めダメージを与える。従って、その後の剥離工程にて生ずる分離層での剥離現象が促進される。

【００２１】請求項５によれば、前記イオン注入工程では、前記イオンにより前記分離層の特性を変化させて、前記分離層と前記基板との密着性を予め弱めておく。従って、その後の剥離工程にて生ずる分離層での剥離現象が促進される。

【００２２】請求項６の発明は、請求項１乃至５のいずれかにおいて、前記第２工程は、薄膜トランジスタを形成するための薄膜トランジスタ形成工程を有し、前記薄膜トランジスタ形成工程はチャネル層形成工程を含み、前記イオン注入工程は、前記チャネル層形成工程の後に実施されることを特徴とする。

【００２３】チャネル形成工程は、他の工程と比較して高温処理工程となる。従って、その前に剥離現象促進用イオンを分離層に注入しておくと、その後の高温処理時にイオンが分離層から放出される虞があるからである。

【００２４】請求項７の発明は、請求項６において、前記薄膜トランジスタ形成工程は、前記チャネル層形成工程後にチャネルパターン形成工程を含み、前記イオン注入工程は、前記チャネルパターン形成工程の後に実施されることを特徴とする。

【００２５】チャネルパターンを形成しておくと、たとえ剥離現象促進用イオンをチャネルパターン側から注入しても、その注入の障害となり得るチャネルパターン自体の面積が少なくなる。従って、イオンを分離層まで到達させやすくなる。

【００２６】請求項８の発明は、請求項６または７において、前記イオン注入工程は、前記チャネル層のうちチャネル領域となる領域上にマスクを形成して実施されることを特徴とする。

【００２７】チャネル領域にイオンが注入されると、トランジスタ特性が劣化する虞があるからである。なお、チャネル領域をマスクしてイオン注入する工程は、チャネルパターン形成前でも形成後でもよい。

【００２８】請求項９において、請求項７において、前記薄膜トランジスタ形成工程は、前記チャネルパターン形成工程後に、該チャネルパターン上にゲート絶縁膜を形成する工程と、該ゲート絶縁膜上にゲート電極を形成する工程と、を含み、前記ゲート電極をマスクとして前記イオン注入工程を実施することを特徴とする。

【００２９】ゲート電極はチャネルと対向する位置に形成されるので、チャネル領域にイオンがチャネル領域に注入するのを防止するマスクとして、ゲート電極を兼用できる。なお、イオンの加速電圧に応じて、ゲート電極上にさらにマスクを形成しても良い。

【００３０】請求項１０の発明は、請求項８または９において、前記イオン注入工程は、前記チャネルパターン内のソース領域及びドレイン領域の少なくとも一方に打ち込まれる不純物イオンと、それよりも質量が軽く前記分離層に打ち込まれる前記イオンとを、同時に注入することを特徴とする。

【００３１】こうすると、分離層へのイオン注入工程と、ソース及び／又はドレイン領域への不純物イオン注入工程とを兼用できる。なお、イオンは、不純物イオンよりも質量が軽いので、ソース、ドレイン領域よりも深い位置にある分離層まで到達できる。

【００３２】請求項１１の発明は、請求項６において、前記薄膜トランジスタ形成工程は、前記チャネル層としてアモルファスシリコン層を形成する工程と、その後前記アモルファスシリコン層をレーザアニールして結晶化させる結晶化工程と、を含み、前記イオン注入工程は、前記結晶化工程の前に実施されることを特徴とする。

【００３３】イオン注入工程の実施により、万一チャネル層にダメージが生じても、その後のレーザアニール工程によって結晶性を高められる。

【００３４】請求項１２の発明は、請求項１乃至１１のいずれかにおいて、前記イオンは水素イオンであることを特徴とする。

【００３５】水素イオンが分離層に注入されると、請求項２～４のそれぞれに示した作用に寄与させることができる。特に、水素イオンは、ソース、ドレインに打ち込まれる不純物イオン（ボロン、リンなど）よりも質量が

軽いので、請求項９の発明の実施にも適している。なお、主に請求項２の気体化を生じさせるイオンとしては水素イオンの他に窒素イオンなどを挙げることができる。また、主に請求項３，４のダメージあるいは密着性低下を生じさせるイオンとしては水素イオンの他にＳｉイオンなどを挙げることができる。

【００３６】請求項１３の発明は、請求項１２において、前記イオン注入工程後に実施される工程のプロセス温度を、３５０℃未満としたことを特徴とする。

【００３７】分離層に注入された水素は、３５０℃以上に加熱されることで抜け始めるので、３５０℃以上のプロセス温度を必要とする工程は、分離層へのイオン注入工程前に実施することが好ましい。

【００３８】請求項１４の発明は、請求項１乃至１３のいずれかに載の剥離方法を用いて前記基板より剥離されて成る薄膜デバイスを定義している。この薄膜デバイスは、分離層からの剥離が容易であるので、剥離時に作用する機械的圧力が少なくて済み、その負荷の大きさに依存する欠陥を少なくすることができる。

【００３９】請求項１５の発明は、マトリクス状に配置された薄膜トランジスタと、その薄膜トランジスタの一端に接続された画素電極とを含んで画素部が構成されるアクティブマトリクス基板であって、請求項６乃至１３のいずれかに記載の方法を用いて前記画素部の薄膜トランジスタを転写することにより製造されたアクティブマトリクス基板を定義している。

【００４０】このアクティブマトリクス基板もまた、請求項１３の発明と同様に欠陥を少なくすることができる。

【００４１】請求項１６の発明は、請求項１５に記載のアクティブマトリクス基板を用いて製造された液晶表示装置を定義している。

【００４２】この液晶表示装置は、請求項１５のアクティブマトリクス基板を用いていることから、液晶表示装置全体としての欠陥も少なくなる。

【００４３】請求項１７の発明に係る薄膜デバイスの転写方法は、基板上に第１分離層を形成する第１工程と、前記第１分離層上に薄膜デバイスを含む被転写層を形成する第２工程と、前記被転写層上に水溶性または有機溶剤溶融性接着剤から成る第２分離層を形成する第３工程と、前記第２分離層上に一次転写体を接合する第４工程と、前記第１分離層を境にして、前記被転写層より前記基板を除去する第５工程と、前記被転写層の下面に二次転写体を接合する第６工程と、前記第２分離層を水または有機溶剤と接触させて、前記第２分離層を境にして、前記被転写層より前記一次転写体を除去する第７工程と、を有し、前記薄膜デバイスを含む前記被転写層を二次転写体に転写することを特徴とする。

【００４４】請求項１７の発明によれば、被転写層の下面より第１分離層を除去し、その下面に二次転写体を接合した後に、第２分離層を境にして、一次転写体を被転写層より離脱させている。こうすると、被転写層に対して、当初の基板が位置していた場所に二次転写体が存在することになり、当初の基板に対する被転写層の積層関係と、二次転写体に対する被転写層の積層関係とが一致する。ここで、第２分離層として水溶性接着剤または有機溶剤溶融性接着剤を用いていることから、一次転写体を離脱させるのに第２分離層を水または有機溶剤と接触させるだけでよい。

【００４５】請求項１８の発明に係る薄膜デバイスの転写方法では、請求項１７の方法発明中の第２分離層として、上記接着剤に代えて、加熱または紫外線により剥離可能な接着剤を用いている。

【００４６】この場合、一次転写体を離脱させるのに第２分離層を加熱または紫外線により剥離可能な接着剤と接触させれば、請求項１７の発明と同様に、当初の基板に対する被転写層の積層関係と、二次転写体に対する被転写層の積層関係とを一致させることができる。

【００４７】

【発明の実施の形態】次に、本発明の実施の形態について図面を参照して説明する。

【００４８】＜第１の実施の形態＞図１～図６は本発明の前提となる薄膜デバイスの転写方法を説明するための図である。

【００４９】[工程１]図1に示すように、基板１００上に分離層（光吸収層）１２０を形成する。

【００５０】以下、基板１００および分離層１２０について説明する。

【００５１】①基板１００についての説明

基板１００は、光が透過し得る透光性を有するものを使用する。

【００５２】この場合、光の透過率は１０％以上であるのが好ましく、５０％以上であるのがより好ましい。この透過率が低過ぎると、光の減衰（ロス）が大きくなり、分離層１２０を剥離するのにより大きな光量を必要とする。

【００５３】また、基板１００は、信頼性の高い材料で構成されているのが好ましく、特に、耐熱性に優れた材料で構成されているのが好ましい。その理由は、例えば後述する被転写層１４０や中間層１４２を形成する際に、その種類や形成方法によってはプロセス温度が高くなる（例えば３５０～１０００℃程度）ことがあるが、その場合でも、基板１００が耐熱性に優れていれば、基板１００上への被転写層１４０等の形成に際し、その温度条件等の成膜条件の設定の幅が広がるからである。

【００５４】従って、基板１００は、被転写層１４０の形成の際の最高温度をＴmaxとしたとき、歪点がＴmax以上の材料で構成されているのものが好ましい。具体的には、基板１００の構成材料は、歪点が３５０℃以上のものが好ましく、５００℃以上のものがより好ましい。こ

のようなものとしては、例えば、石英ガラス、コーニング７０５９、日本電気ガラスＯＡ－２等の耐熱性ガラスが挙げられる。

【００５５】また、基板１００の厚さは、特に限定されないが、通常は、０．１～５．０㎜程度であるのが好ましく、０．５～１．５㎜程度であるのがより好ましい。基板１００の厚さが薄すぎると強度の低下を招き、厚すぎると、基板１００の透過率が低い場合に、光の減衰を生じ易くなる。なお、基板１００の光の透過率が高い場合には、その厚さは、前記上限値を超えるものであってもよい。なお、光を均一に照射できるように、基板１００の厚さは、均一であるのが好ましい。

【００５６】②分離層１２０の説明

分離層１２０は、物理的作用（光、熱など）、化学的作用（薬液等との化学反応など）あるいは機械的作用（引っ張り力、振動など）のいずれか一つあるいは複数の作用を受けることで、その結合力が減少されあるいは消滅され、それによりこの分離層１２０を介して基板１００の分離を促すものである。

【００５７】この分離層１２０として例えば、照射される光を吸収し、その層内および／または界面において剥離（以下、「層内剥離」、「界面剥離」と言う）を生じるような性質を有するものを挙げることができる。好ましくは、光の照射により、分離層１２０を構成する物質の原子間または分子間の結合力が消失または減少すること、すなわち、アブレーションが生じて層内剥離および／または界面剥離に至るものがよい。

【００５８】さらに、光の照射により、分離層１２０から気体が放出され、分離効果が発現される場合もある。すなわち、分離層１２０に含有されていた成分が気体となって放出される場合と、分離層１２０が光を吸収して一瞬気体になり、その蒸気が放出され、分離に寄与する場合とがある。

【００５９】本発明では、このような特性を有する分離層１２０を形成後に、分離層１２０内に剥離促進用イオンを注入することが特徴であり、それによりその後の工程での分離層１２０での剥離現象を促進させるものである。従って、剥離促進用イオンとしては、上述した物理的作用、化学的作用あるいは機械的作用による剥離現象を促進させるものであれば種類は問わない。

【００６０】次に、このような分離層１２０の組成としては、例えば、次のＡ～Ｅに記載されるものが挙げられる。

【００６１】Ａ．アモルファスシリコン（ａ－Ｓｉ）

このアモルファスシリコン中には、水素（Ｈ）が含有されていてもよい。この場合、Ｈの含有量は、２原子％以上程度であるのが好ましく、２～２０原子％程度であるのがより好ましい。このように、水素（Ｈ）が所定量含有されていると、後に光が照射にされることによって水素が放出され、分離層１２０に内圧が発生し、それが上下の薄膜を剥離する力となる。アモルファスシリコン中の水素（Ｈ）の含有量は、成膜条件、例えばＣＶＤにおけるガス組成、ガス圧、ガス雰囲気、ガス流量、温度、基板温度、投入パワー等の条件を適宜設定することにより調整することができる。

【００６２】本実施の形態では、このプロセス条件によって分離層１２０中に水素を含有させる他に、後述する通り、アモルファスシリコン層の形成後のいずれかの時期に、剥離促進用イオンとして水素イオンをイオン注入することができる。これにより、アモルファスシリコンのプロセス条件に左右されずに、一定量以上の水素をアモルファスシリコン層内に含有させることができる。

【００６３】Ｂ．酸化ケイ素又はケイ酸化合物、酸化チタンまたはチタン酸化合物、酸化ジルコニウムまたはジルコン酸化合物、酸化ランタンまたはランタン酸化化合物等の各種酸化物セラミックス、透電体（強誘電体）あるいは半導体

酸化ケイ素としては、SiO、SiO_2、Si_3O_2が挙げられ、ケイ酸化合物としては、例えばK_2SiO_3、Li_2SiO_3、$CaSiO_3$、$ZrSiO_4$、Na_2SiO_3が挙げられる。

【００６４】酸化チタンとしては、TiO、Ti_2O_3、TiO_2が挙げられ、チタン酸化合物としては、例えば、$BaTiO_4$、$BaTiO_3$、$Ba_2Ti_9O_{20}$、$BaTi_5O_{11}$、$CaTiO_3$、$SrTiO_3$、$PbTiO_3$、$MgTiO_3$、$ZrTiO_2$、$SnTiO_4$、Al_2TiO_5、$FeTiO_3$が挙げられる。

【００６５】酸化ジルコニウムとしては、ZrO_2が挙げられ、ジルコン酸化合物としては、例えば$BaZrO_3$、$ZrSiO_4$、$PbZrO_3$、$MgZrO_3$、K_2ZrO_3が挙げられる。

【００６６】Ｃ．ＰＺＴ、ＰＬＺＴ、ＰＬＬＺＴ、ＰＢＺＴ等のセラミックスあるいは誘電体（強誘電体）

Ｄ．窒化珪素、窒化アルミ、窒化チタン等の窒化物セラミックス

Ｅ．有機高分子材料

有機高分子材料としては、－ＣＨ－、－ＣＯ－（ケトン）、－ＣＯＮＨ－（アミド）、－ＮＨ－（イミド）、－ＣＯＯ－（エステル）、－Ｎ＝Ｎ－（アゾ）、－ＣＨ＝Ｎ－（シフ）等の結合（光の照射によりこれらの結合が切断される）を有するもの、特に、これらの結合を多く有するものであればいかなるものでもよい。また、有機高分子材料は、構成式中に芳香族炭化水素（１または２以上のベンゼン環またはその縮合環）を有するものであってもよい。

【００６７】このような有機高分子材料の具体例としては、ポリエチレン，ポリプロピレンのようなポリオレフィン，ポリイミド，ポリアミド，ポリエステル，ポリメチルメタクリレート（ＰＭＭＡ），ポリフェニレンサルファイド（ＰＰＳ），ポリエーテルスルホン（ＰＥ

Ｓ），エポキシ樹脂等があげられる。

【００６８】Ｆ．金属

金属としては、例えば、Ａｌ，Ｌｉ，Ｔｉ，Ｍｎ，Ｉｎ，Ｓｎ，Ｙ，Ｌａ，Ｃｅ，Ｎｄ，Ｐｒ，Ｇｄ，Ｓｍまたはこれらのうちの少なくとも１種を含む合金が挙げられる。

【００６９】また、分離層１２０の厚さは、剥離目的や分離層１２０の組成、層構成、形成方法等の諸条件により異なるが、通常は、１ｎｍ～２０μｍ程度であるのが好ましく、５ｎｍ～２μｍ程度であるのがより好ましく、５ｎｍ～１μｍ程度であるのがさらに好ましい。分離層１２０の膜厚が小さすぎると、成膜の均一性が損なわれ、剥離にムラが生じることがあり、また、膜厚が厚すぎると、分離層１２０の良好な剥離性を確保するために、光のパワー（光量）を大きくする必要があるとともに、後に分離層１２０を除去する際に、その作業に時間がかかる。なお、分離層１２０の膜厚は、できるだけ均一であるのが好ましい。

【００７０】分離層１２０の形成方法は、特に限定されず、膜組成や膜厚等の諸条件に応じて適宜選択される。たとえば、ＣＶＤ（ＭＯＣＶＤ、低圧ＣＶＤ、ＥＣＲ－ＣＶＤを含む）、蒸着、分子線蒸着（ＭＢ）、スパッタリング、イオンプレーティング、ＰＶＤ等の各種気相成膜法、電気メッキ、浸漬メッキ（ディッピング）、無電解メッキ等の各種メッキ法、ラングミュア・プロジェット（ＬＢ）法、スピンコート、スプレーコート、ロールコート等の塗布法、各種印刷法、転写法、インクジェット法、粉末ジェット法等が挙げられ、これらのうちの２以上を組み合わせて形成することもできる。

【００７１】例えば、分離層１２０の組成がアモルファスシリコン（ａ－Ｓｉ）の場合には、ＣＶＤ、特に低圧ＣＶＤやプラズマＣＶＤにより成膜するのが好ましい。

【００７２】また、分離層１２０をゾルーゲル法によるセラミックスで構成する場合や、有機高分子材料で構成する場合には、塗布法、特に、スピンコートにより成膜するのが好ましい。

【００７３】[工程２]次に、図２に示すように、分離層１２０上に、被転写層（薄膜デバイス層）１４０を形成する。この工程２以降の詳細は、後に図８～図１８を参照して説明するが、本実施の形態では、図８～図１３の工程途中にて、分離層１２０への剥離促進用イオン注入工程を実施している。

【００７４】この薄膜デバイス層１４０のＫ部分（図２において１点線鎖線で囲んで示される部分）の拡大断面図を、図２の右側に示す。図示されるように、薄膜デバイス層１４０は、例えば、SiO_2膜（中間層）１４２上に形成されたＴＦＴ（薄膜トランジスタ）を含んで構成され、このＴＦＴは、ポリシリコン層にｎ型不純物を導入して形成されたソース，ドレイン層１４６と、チャネル層１４４と、ゲート絶縁膜１４８と、ゲート電極１５０と、層間絶縁膜１５４と、例えばアルミニュウムからなる電極１５２とを具備する。

【００７５】本実施の形態では、分離層１２０に接して設けられる中間層としてSiO_2膜を使用しているが、Si_3N_4などのその他の絶縁膜を使用することもできる。SiO_2膜（中間層）の厚みは、その形成目的や発揮し得る機能の程度に応じて適宜決定されるが、通常は、１０nm～５μm程度であるのが好ましく、４０nm～１μm程度であるのがより好ましい。中間層は、種々の目的で形成され、例えば、被転写層１４０を物理的または化学的に保護する保護層，絶縁層，導電層，レーザー光の遮光層，マイグレーション防止用のバリア層，反射層としての機能の内の少なくとも１つを発揮するものが挙げられる。

【００７６】なお、場合によっては、SiO_2膜等の中間層を形成せず、分離層１２０上に直接被転写層（薄膜デバイス層）１４０を形成してもよい。

【００７７】被転写層１４０（薄膜デバイス層）は、図２の右側に示されるようなＴＦＴ等の薄膜デバイスを含む層である。

【００７８】薄膜デバイスとしては、ＴＦＴの他に、例えば、薄膜ダイオードや、シリコンのＰＩＮ接合からなる光電変換素子（光センサ、太陽電池）やシリコン抵抗素子、その他の薄膜半導体デバイス、電極（例：ＩＴＯ、メサ膜のような透明電極）、スイッチング素子、メモリー、圧電素子等のアクチュエータ、マイクロミラー（ピエゾ薄膜セラミックス）、磁気記録薄膜ヘッド、コイル、インダクター、薄膜高透磁材料およびそれらを組み合わせたマイクロ磁気デバイス、フィルター、反射膜、ダイクロイックミラー等がある。

【００７９】このような薄膜デバイスは、その形成方法との関係で、通常、比較的高いプロセス温度を経て形成される。したがって、この場合、前述したように、基板１００としては、そのプロセス温度に耐え得る信頼性の高いものが必要となる。

【００８０】[工程３]次に、図３に示すように、薄膜デバイス層１４０を、接着層１６０を介して転写体１８０に接合（接着）する。

【００８１】接着層１６０を構成する接着剤の好適な例としては、反応硬化型接着剤、熱硬化型接着剤、紫外線硬化型接着剤等の光硬化型接着剤、嫌気硬化型接着剤等の各種硬化型接着剤が挙げられる。接着剤の組成としては、例えば、エポキシ系、アクリレート系、シリコーン系等、いかなるものでもよい。このような接着層１６０の形成は、例えば、塗布法によりなされる。

【００８２】前記硬化型接着剤を用いる場合、例えば被転写層（薄膜デバイス層）１４０上に硬化型接着剤を塗布し、その上に転写体１８０を接合した後、硬化型接着剤の特性に応じた硬化方法により前記硬化型接着剤を硬化させて、被転写層（薄膜デバイス層）１４０と転写体

１８０とを接着し、固定する。

【００８３】接着剤が光硬化型の場合、光透過性の基板１００または光透過性の転写体１８０の一方の外側から（あるいは光透過性の基板及び転写体の両外側から）光を照射する。接着剤としては、薄膜デバイス層に影響を与えにくい紫外線硬化型などの光硬化型接着剤が好ましい。

【００８４】接着層１６０として、水溶性接着剤を用いることもできる。この種の水溶性接着剤として、例えばケミテック株式会社製のケミシール　Ｕ－４５１Ｄ（商品名）、株式会社スリーボンド製のスリーボンド３０４６（商品名）などを挙げることができる。

【００８５】接着層１６０として、各種の有機溶剤に対して溶融性のある接着剤を用いることもできる。

【００８６】接着層１６０として、加熱により剥離作用を呈する接着剤を用いることもできる。この種の接着剤として、例えば日東デンコー製のリバアルファ（商品名）を用いることができる。

【００８７】接着層１６０として、紫外線照射により剥離作用を呈する接着剤を用いることもできる。この種の接着剤として、例えばリンテック株式会社製のガラス・セラミック用ダイシングテープＤ－２１０，Ｄ－６３６を用いることができる。

【００８８】なお、図示と異なり、転写体１８０側に接着層１６０を形成し、その上に被転写層（薄膜デバイス層）１４０を接着してもよい。なお、例えば転写体１８０自体が接着機能を有する場合等には、接着層１６０の形成を省略してもよい。

【００８９】転写体１８０としては、特に限定されないが、基板（板材）、特に透明基板が挙げられる。なお、このような基板は平板であっても、湾曲板であってもよい。また、転写体１８０は、前記基板１００に比べ、耐熱性、耐食性等の特性が劣るものであってもよい。その理由は、本発明では、基板１００側に被転写層（薄膜デバイス層）１４０を形成し、その後、被転写層（薄膜デバイス層）１４０を転写体１８０に転写するため、転写体１８０に要求される特性、特に耐熱性は、被転写層（薄膜デバイス層）１４０の形成の際の温度条件等に依存しないからである。

【００９０】したがって、被転写層１４０の形成の際の最高温度をTmaxとしたとき、転写体０の構成材料として、ガラス転移点（Ｔｇ）または軟化点がTmax以下のものを用いることができる。例えば、転写体１８０は、ガラス転移点（Ｔｇ）または軟化点が好ましくは８００℃以下、より好ましくは５００℃以下、さらに好ましくは３２０℃以下の材料で構成することができる。

【００９１】また、転写体１８０の機械的特性としては、ある程度の剛性（強度）を有するものが好ましいが、可撓性、弾性を有するものであってもよい。

【００９２】このような転写体１８０の構成材料としては、各種合成樹脂または各種ガラス材が挙げられ、特に、各種合成樹脂や通常の（低融点の）安価なガラス材が好ましい。

【００９３】合成樹脂としては、熱可塑性樹脂、熱硬化性樹脂のいずれでもよく、例えば、ポリエチレン、ポロプロピレン、エチレン－プレピレン共重合体、エチレン－酢酸ビニル共重合体（ＥＶＡ）等のポリオレフィン、環状ポリオレフィン、変性ポリオレフィン、ポリ塩化ビニル、ポリ塩化ビニリデン、ポリスチレン、ポリアミド、ポリイミド、ポリアミドイミド、ポリカーボネート、ポリ－（４－メチルベンテン－１）、アイオノマー、アクリル系樹脂、ポリメチルメタクリレート、アクリル－スチレン共重合体（ＡＳ樹脂）、ブタジエン－スチレン共重合体、ポリオ共重合体（ＥＶＯＨ）、ポリエチレンテレフタレート（ＰＥＴ）、ポリプチレンテレフタレート（ＰＢＴ）、プリシクロヘキサンテレフタレート（ＰＣＴ）等のポリエステル、ポリエーテル、ポリエーテルケトン（ＰＥＫ）、ポリエーテルエーテルケトン（ＰＥＥＫ）、ポリエーテルイミド、ポリアセタール（ＰＯＭ）、ポリフェニレンオキシド、変性ポリフェニレンオキシド、ポリアリレート、芳香族ポリエステル（液晶ポリマー）、ポリテトラフルオロエチレン、ポリフッ化ビニリデン、その他フッ素系樹脂、スチレン系、ポリオレフィン系、ポリ塩化ビニル系、ポリウレタン系、フッ素ゴム系、塩素化ポリエチレン系等の各種熱可塑性エラストマー、エボキシ樹脂、フェノール樹脂、ユリア樹脂、メラミン樹脂、不飽和ポリエステル、シリコーン樹脂、ポリウレタン等、またはこれらを主とする共重合体、ブレンド体、ポリマーアロイ等が挙げられ、これらのうちの１種または２種以上を組み合わせて（例えば２層以上の積層体として）用いることができる。

【００９４】ガラス材としては、例えば、ケイ酸ガラス（石英ガラス）、ケイ酸アルカリガラス、ソーダ石灰ガラス、カリ石灰ガラス、鉛（アルカリ）ガラス、バリウムガラス、ホウケイ酸ガラス等が挙げられる。このうち、ケイ酸ガラス以外のものは、ケイ酸ガラスに比べて融点が低く、また、成形、加工も比較的容易であり、しかも安価であり、好ましい。

【００９５】転写体１８０として合成樹脂で構成されたものを用いる場合には、大型の転写体１８０を一体的に成形することができるとともに、湾曲面や凹凸を有するもの等の複雑な形状であっても容易に製造することができ、また、材料コスト、製造コストも安価であるという種々の利点が享受できる。したがって、合成樹脂の使用は、大型で安価なデバイス（例えば、液晶ディスプレイ）を製造する上で有利である。

【００９６】なお、転写体１８０は、例えば、液晶セルのように、それ自体独立したデバイスを構成するものや、例えばカラーフィルター、電極層、誘電体層、絶縁層、半導体素子のように、デバイスの一部を構成するも

のであってもよい。

【００９７】さらに、転写体１８０は、金属、セラミックス、石材、木材紙等の物質であってもよいし、ある品物を構成する任意の面上（時計の面上、エアコンの表面上、プリント基板の上等）、さらには壁、柱、天井、窓ガラス等の構造物の表面上であってもよい。

【００９８】［工程４］次に、図４に示すように、基板１００の裏面側から光を照射する。

【００９９】この光は、基板１００を透過した後に分離層１２０に照射される。これにより、分離層１２０に層内剥離および／または界面剥離が生じ、結合力が減少または消滅する。

【０１００】分離層１２０の層内剥離および／または界面剥離が生じる原理は、分離層１２０の構成材料にアブレーションが生じること、また、分離層１２０に含まれているガスの放出、さらには照射直後に生じる溶融、蒸散等の相変化によるものであることが推定される。

【０１０１】ここで、アブレーションとは、照射光を吸収した固定材料（分離層１２０の構成材料）が光化学的または熱的に励起され、その表面や内部の原子または分子の結合が切断されて放出することをいい、主に、分離層１２０の構成材料の全部または一部が溶融、蒸散（気化）等の相変化を生じる現象として現れる。また、前記相変化によって微小な発砲状態となり、結合力が低下することもある。

【０１０２】分離層１２０が層内剥離を生じるか、界面剥離を生じるか、またはその両方であるかは、分離層１２０の組成や、その他種々の要因に左右され、その要因の１つとして、照射される光の種類、波長、強度、到達深さ等の条件が挙げられる。

【０１０３】ここで、本実施の形態では、分離層１２０の形成後に、この第４工程にて分離層１２０自体に剥離現象をより確実に生じさせるために、剥離促進用イオンが注入されている。

【０１０４】この剥離促進用イオンは、少なくとも以下の３つのいずれか或いは２つ以上の組合せの作用をなし、第４工程における分離層１２０の剥離現象を促進させる。

【０１０５】その一つは、この第４工程の実施により、分離層１２０に注入された剥離促進用イオン例えば水素（Ｈ）あるいは窒素（Ｎ）が気体化され、それにより分離層１２０の剥離が促進される。

【０１０６】他の一つは、剥離促進用イオン注入工程において、その剥離促進用イオン例えば水素（Ｈ）、窒素（Ｎ）あるいはシリコン（Ｓｉ）により分離層１２０を構成する原子または分子の結合を切断して、分離層１２０に予めダメージを与えている。従って、予めダメージが与えられた分離層１２０では、第４工程の実施により比較的容易に剥離が生ずる。

【０１０７】さらに他の一つは、剥離促進用イオン注入工程において、その剥離促進用イオン例えば水素（Ｈ）、窒素（Ｎ）あるいはシリコン（Ｓｉ）により分離層１２０の特性を変化させて、分離層１２０と基板１００との密着性が予め弱められている。この場合にも、基板との密着性が弱められた分離層１２０では、第４工程の実施により比較的容易に剥離が生ずる。

【０１０８】第４工程にて照射される光としては、分離層１２０に層内剥離および／または界面剥離を起こさせるものであればいかなるものでもよく、例えば、Ｘ線、紫外線、可視光、赤外線（熱線）、レーザ光、ミリ波、マイクロ波、電子線、放射線（α線、β線、γ線）等が挙げられる。そのなかでも、分離層１２０の剥離（アブレーション）を生じさせ易いという点で、レーザ光が好ましい。

【０１０９】このレーザ光を発生させるレーザ装置としては、各種気体レーザ、固体レーザ（半導体レーザ）等が挙げられるが、エキシマレーザ、Ｎｄ－ＹＡＧレーザ、Ａｒレーザ、CO_2レーザ、ＣＯレーザ、Ｈｅ－Ｎｅレーザ等が好適に用いられ、その中でもエキシマレーザが特に好ましい。

【０１１０】エキシマレーザは、短波長域で高エネルギーを出力するため、極めて短時間で分離層１２０にアブレーションを生じさせることができ、よって隣接する転写体１８０や基板１００等に温度上昇をほとんど生じさせることなく、すなわち劣化、損傷を生じさせることなく、分離層１２０を剥離することができる。

【０１１１】また、分離層１２０にアブレーションを生じさせるに際して、光の波長依存性がある場合、照射されるレーザ光の波長は、１００ｎｍ～３５０ｎｍ程度であるのが好ましい。

【０１１２】図７に、基板１００の、光の波長に対する透過率の一例を示す。図示されるように、２００ｎｍの波長に対して透過率が急峻に増大する特性をもつ。このような場合には、２１０ｎｍ以上の波長の光、例えば、Ｘｅ－Ｃｌエキシマレーザー光（波長３０８ｎｍ）、ＫｒＦレーザー光（波長２４８ｎｍ）などを照射する。

【０１１３】また、分離層１２０に、例えばガス放出、気化、昇華等の相変化を起こさせて分離特性を与える場合、照射されるレーザ光の波長は、３５０から１２００ｎｍ程度であるのが好ましい。

【０１１４】また、照射されるレーザ光のエネルギー密度、特に、エキシマレーザの場合のエネルギー密度は、１０～５０００ｍＪ／cm^2程度とするのが好ましく、１００～５００ｍＪ／cm^2程度とするのがより好ましい。また、照射時間は、１～１０００ｎｓｅｃ程度とするのが好ましく、１０～１００ｎｓｅｃ程度とするのがより好ましい。エネルギー密度が低いかまたは照射時間が短いと、十分なアブレーション等が生じず、また、エネルギー密度が高いかまたは照射時間が長いと、分離層１２０を透過した照射光により被転写層１４０に悪影響

を及ぼすおそれがある。

【０１１５】なお、分離層１２０を透過した照射光が被転写層１４０にまで達して悪影響を及ぼす場合の対策としては、例えば、図３０に示すように、分離層（レーザー吸収層）１２０上にタンタル（Ｔａ）等の金属膜１２４を形成する方法がある。これにより、分離層１２０を透過したレーザー光は、金属膜１２４の界面で完全に反射され、それよりの上の薄膜デバイスに悪影響を与えない。

【０１１６】次に、図５に示すように、基板１００に力を加えて、この基板１００を分離層１２０から離脱させる。図５では図示されないが、この離脱後、基板１００上に分離層が付着することもある。

【０１１７】次に、図６に示すように、残存している分離層１２０を、例えば洗浄、エッチング、アッシング、研磨等の方法またはこれらを組み合わせた方法により除去する。これにより、被転写層（薄膜デバイス層）１４０が、転写体１８０に転写されたことになる。

【０１１８】なお、離脱した基板１００にも分離層の一部が付着している場合には同様に除去する。なお、基板１００が石英ガラスのような高価な材料、希少な材料で構成されている場合等には、基板１００は、好ましくは再利用（リサイクル）に供される。すなわち、再利用したい基板１００に対し、本発明を適用することができ、有用性が高い。

【０１１９】以上のような各工程を経て、被転写層（薄膜デバイス層）１４０の転写体１８０への転写が完了する。その後、被転写層（薄膜デバイス層）１４０に隣接するSiO_2膜の除去や、被転写層１４０上への配線等の導電層や所望の保護膜の形成等を行うこともできる。

【０１２０】このように、被剥離物である被転写層（薄膜デバイス層）１４０自体を直接に剥離するのではなく、被転写層（薄膜デバイス層）１４０に接合された分離層において剥離するため、被剥離物（被転写層１４０）の特性、条件等にかかわらず、容易かつ確実に、しかも均一に剥離（転写）することができ、剥離操作に伴う被剥離物（被転写層１４０）へのダメージもなく、被転写層１４０の高い信頼性を維持することができる。

【０１２１】次に、基板１００及び分離層１２０上に、薄膜デバイス層１４０として例えばＣＭＯＳ構造のＴＦＴを形成し、これを転写体に転写する場合の具体的な製造プロセスの例を図８～図１８を用いて説明する。なお、このプロセス途中にて実施される剥離促進用イオン注入工程についても説明する。

【０１２２】（工程１）図８に示すように、透光性基板（例えば石英基板）１００上に、分離層（例えば、ＬＰＣＶＤ法により形成されたアモルファスシリコン層）１２０と、中間層（例えば、SiO_2膜）１４２と、アモルファスシリコン層（例えばＬＰＣＶＤ法により形成される）１４３とを順次に積層形成し、続いて、アモルファスシリコン層１４３の全面に上方からレーザー光を照射し、アニールを施す。これにより、アモルファスシリコン層１４３は再結晶化してポリシリコン層となる。なお、この場合のレーザアニールをビームスキャンによって実施する場合には、上述の分離層１２０へのビームスキャンとは異なり、各回のビームのビーム中心同士が重なるように（ガウシアンビームの場合は除く）、同一箇所に２度以上光照射されることが好ましい。この場合には光漏れなどの弊害はなく、多重照射することでアモルファスシリコン層１４３を十分に再結晶化できるからである。

【０１２３】剥離促進用イオンの注入工程の実施時期としては、分離層１２０の形成後であって、結晶化のためのレーザアニール工程の前であれば、マスクを必要とせずにイオン注入が実施できる点で好ましい。

【０１２４】従って、その実施時期としては、

（Ａ）図８の分離層１２０の形成後であって中間層１４２の形成前

（Ｂ）中間層１４２の形成後であってアモルファスシリコン層１４３の形成前

（Ｃ）アモルファスシリコン層１４３の形成後あって、その結晶化のためのレーザアニール工程の前

のいずれかとなる。この（Ａ）～（Ｃ）の中では、（Ｃ）の実施時期が最も好ましい。その理由は、アモルファスシリコン層１４３の形成工程すなわちチャネル層の形成工程は、現状で４２５℃程度のプロセス温度となる。この際、例えば剥離促進用イオンとして水素イオンを既に分離層１２０に注入してある場合には、水素が３５０℃以上の温度にて分離層１２０から抜け出る虞がある。従って、剥離促進用イオンの注入工程は、チャネル層形成後の実施時期（Ｃ）にて行うことが好ましい。ただし、剥離促進用イオンの種類によってはそのような制限がないため、実施時期（Ａ）（Ｂ）でも実施可能である。また、アモルファスシリコン層１４３がレーザアニールされて多結晶化された後の層に、剥離促進用イオンの注入に起因したダメージが生じていないことが、トランジスタ特性上好ましい。（Ａ）（Ｂ）の場合にはダメージの発生自体が無く、（Ｃ）の場合には、たとえアモルファスシリコン層１４３自体にダメージが生じたとしても、その後の結晶化工程によりそのダメージの影響が低減される。

【０１２５】なお、この剥離促進用イオン注入工程は、公知のイオン注入装置を用いて実施することができる。すなわち、例えば水素イオンを注入するのであれば、水素を含むガスをプラズマ化し、それによって生成された水素イオンを電界によって加速することで、分離層１２０に注入できる。

【０１２６】イオン注入工程の実施時期（Ｄ）としては、レーザアニール後であってもよい。この場合には、チャネル領域となる部分をマスクしてイオン注入すれ

ば、トランジスタ特性を劣化させることがない。なお、イオン注入工程後にマスクは除去される。に

（工程２）続いて、図９に示すように、レーザーアニールにより得られたポリシリコン層をパターニングして、チャネルパターンとしてアイランド１４４ａ，１４４ｂを形成する。

【０１２７】剥離促進用イオン注入工程は、その実施時期（Ｅ）として、上述した（Ａ）～（Ｄ）以外にも、第２工程（チャネルパターン形成工程）後に実施することができる。この場合には、図３１に示すように、アイランド１４４ａ，１４４ｂ上であって、アイランド１４４ａ，１４４ｂ内のチャネル領域と対向する部分に、マスクパターン２０１を形成しておく。そして、その状態で剥離促進用イオン例えば水素イオンを、分離層１２０に向けて注入する。これにより、チャネル領域に水素が含有されることが無く、トランジスタ特性が劣化しない。なお、剥離促進用イオン注入工程が終了したら、マスクパターン２０１は除去される。

【０１２８】（工程３）図１０に示されるように、アイランド１４４ａ，１４４ｂを覆うゲート絶縁膜１４８ａ，１４８ｂを、例えば、ＣＶＤ法により形成する。

【０１２９】剥離促進用イオン注入工程は、その実施時期（Ｆ）として、上述した（Ａ）～（Ｅ）以外にも、第３工程（ゲート絶縁膜）後に実施することができる。この場合には、図３２に示すように、ゲート絶縁膜１４８ａ，１４８ｂ上であって、アイランド１４４ａ，１４４ｂ内のチャネル領域と対向する部分に、マスクパターン２０２を形成しておくことが好ましい。

【０１３０】（工程４）図１１に示されるように、ポリシリコンあるいはメタル等からなるゲート電極１５０ａ，１５０ｂを形成する。

【０１３１】（工程５）図１２に示すように、ポリイミド等からなるマスク層１７０を形成し、ゲート電極１５０ｂおよびマスク層１７０をマスクとして用い、セルフアラインで、例えばボロン（Ｂ）のイオン注入を行う。これによって、p^+層１７２ａ，１７２ｂが形成される。

【０１３２】剥離促進用イオン注入工程は、その実施時期（Ｇ）として、上述した（Ａ）～（Ｆ）以外にも、このボロンイオン注入工程と同時に実施することができる。この場合、例えばB_2H_6（５％）＋H_2（９５％）の混合ガスをプラズマ化し、それにより生成されたボロンイオン及び水素イオンを加速して、質量分析器を介さずに基板に導く。そうすると、同じ加速電圧であっても、質量の重いボロンイオンは上層側の多結晶シリコン層に止まる一方で、質量の軽い水素イオンはより深く打ち込まれて、分離層１２０まで到達する。

【０１３３】なお、このときゲート電極１５０ｂが図３１のマスクパターン２０１あるいは図３２のマスクパターン２０２と同様に機能するが、加速電圧に応じてゲート電極１５０ｂ上にさらにマスク層を設けることができる。

【０１３４】（工程６）図１３に示すように、ポリイミド等からなるマスク層１７４を形成し、ゲート電極１５０ａおよびマスク層１７４をマスクとして用い、セルフアラインで、例えばリン（Ｐ）のイオン注入を行う。これによって、n^+層１４６ａ，１４６ｂが形成される。

【０１３５】剥離促進用イオン注入工程は、その実施時期（Ｈ）として、上述した（Ａ）～（Ｇ）以外にも、このリンイオン注入工程と同時に実施することができる。この場合も、例えばPH_3（５％）＋H_2（９５％）の混合ガスをプラズマ化し、それにより生成されたリンイオン及び水素イオンを加速して、質量分析器を介さずに基板に導く。そうすると、同じ加速電圧であっても、質量の重いリンイオンは上層側の多結晶シリコン層に止まる一方で、質量の軽い水素イオンはより深く打ち込まれて、分離層１２０まで到達する。

【０１３６】なお、この場合はゲート電極１５０ａが図３１のマスクパターン２０１あるいは図３２のマスクパターン２０２と同様に機能するが、加速電圧に応じてゲート電極１５０ａ上にさらにマスク層を設けることができる。

【０１３７】また、上記の剥離促進用イオン注入工程の実施時期（Ｇ）（Ｈ）は、工程５及び工程６でのソース、ドレイン領域への不純物イオン注入工程と同時であったが、その前後で別個に行うものでも良い。

【０１３８】（工程７）図１４に示すように、層間絶縁膜１５４を形成し、選択的にコンタクトホール形成後、電極１５２ａ～１５２ｄを形成する。

【０１３９】このようにして形成されたＣＭＯＳ構造のＴＦＴが、図２～図６における被転写層（薄膜デバイス層）１４０に該当する。なお、層間絶縁膜１５４上に保護膜を形成してもよい。

【０１４０】（工程８）図１５に示すように、ＣＭＯＳ構成のＴＦＴ上に接着層としてのエポキシ樹脂層１６０を形成し、次に、そのエポキシ樹脂層１６０を介して、ＴＦＴを転写体（例えば、ソーダガラス基板）１８０に貼り付ける。続いて、熱を加えてエポキシ樹脂を硬化させ、転写体１８０とＴＦＴとを接着（接合）する。

【０１４１】なお、接着層１６０は紫外線硬化型接着剤であるフォトポリマー樹脂でもよい。この場合は、熱ではなく転写体１８０側から紫外線を照射してポリマーを硬化させる。

【０１４２】（工程９）図１６に示すように、透光性基板１００の裏面から、例えば、Ｘｅ－Ｃｌエキシマレーザー光を照射する。これにより、分離層１２０の層内および／または界面において剥離を生じせしめる。

【０１４３】（工程１０）図１７に示すように、基板１００を引き剥がす。

【０１４４】（工程１１）最後に、分離層１２０をエッ

チングにより除去する。これにより、図１８に示すように、ＣＭＯＳ構成のＴＦＴが、転写体１８０に転写されたことになる。

【０１４５】＜第２の実施の形態＞次に、本発明の第２の実施の形態について、図３３～図３５を参照して説明する。なお、この第２の実施の形態は、薄膜デバイス層から構成される被転写層１４０を２度転写するものであり、第１の実施の形態の図１～図６の工程に加えて、図３３～図３５の工程が追加される。

【０１４６】ここで、この第２の実施の形態では、図２～図５に示す分離層１２０が第１分離層と称される。また、この第２の実施の形態では、図３～図６の接着層１６０が第２分離層と称される。さらに、この第２の実施の形態では、図３～図６の転写体１８０が一次転写体と称される。従って、この第２の実施の形態によれば、図６の工程が終了した段階では、被転写層１４０は第２分離層１６０を介して一次転写体１８０に転写されたことになる。

【０１４７】ここで、第２の実施の形態では、第２分離層１６０の材質は熱溶融性接着剤、水溶性接着剤だけでなく、第１分離層１２０と同じ材質のものを用いることができる。このとき、この第２分離層１６０での剥離を容易とするために、上述した第１の実施の形態にて説明したイオン注入を行うことができる。

【０１４８】以下、図６の工程後に実施される図３３～図３５の追加工程１～３について説明する。

【０１４９】[追加工程１]図６の工程に続いて、図３３に示すように、薄膜デバイス層１４０の下面（露出面）に、接着層１９０を介して、二次転写層２００を接着する。

【０１５０】接着層１９０を構成する接着剤の好適な例としては、反応硬化型接着剤、熱硬化型接着剤、紫外線硬化型接着剤等の光硬化型接着剤、嫌気硬化型接着剤等の各種硬化型接着剤が挙げられる。接着剤の組成としては、例えば、エポキシ系、アクリレート系、シリコーン系等、いかなるものでもよい。このような接着層１９０の形成は、例えば、塗布法によりなされる。

【０１５１】前記硬化型接着剤を用いる場合、例えば被転写層（薄膜デバイス層）１４０の下面に硬化型接着剤を塗布し、さらに二次転写体２００を接合した後、硬化型接着剤の特性に応じた硬化方法により前記硬化型接着剤を硬化させて、被転写層（薄膜デバイス層）１４０と二次転写体２００とを接着し、固定する。

【０１５２】接着剤が光硬化型の場合、好ましくは光透過性の二次転写体２００の外側から光を照射する。接着剤としては、薄膜デバイス層に影響を与えにくい紫外線硬化型などの光硬化型接着剤を用いれば、光透過性の一次転写体１８０側から、あるいは光透過性の一次、二次転写体１８０，２００の両側から光照射しても良い。

【０１５３】なお、図示と異なり、二次転写体２００側に接着層１９０を形成し、その上に被転写層（薄膜デバイス層）１４０を接着してもよい。なお、例えば二次転写体２００自体が接着機能を有する場合等には、接着層１９０の形成を省略してもよい。

【０１５４】二次転写体２００としては、特に限定されないが、基板（板材）、特に透明基板が挙げられる。なお、このような基板は平板であっても、湾曲板であってもよい。

【０１５５】また、二次転写体２００は、前記基板１００に比べ、耐熱性、耐食性等の特性が劣るものであってもよい。その理由は、本発明では、基板１００側に被転写層（薄膜デバイス層）１４０を形成し、その後、被転写層（薄膜デバイス層）１４０を二次転写体２００に転写するため、二次転写体２００に要求される特性、特に耐熱性は、被転写層（薄膜デバイス層）１４０の形成の際の温度条件等に依存しないからである。この点は、一次転写体１８０についても同様である。

【０１５６】したがって、被転写層１４０の形成の際の最高温度をＴmaxとしたとき、一次、二次転写体１８０，２００の構成材料として、ガラス転移点（Ｔｇ）または軟化点がＴmax以下のものを用いることができる。例えば、一次、二次転写体１８０，２００は、ガラス転移点（Ｔｇ）または軟化点が好ましくは８００℃以下、より好ましくは５００℃以下、さらに好ましくは３２０℃以下の材料で構成することができる。

【０１５７】また、一次、二次転写体１８０，２００の機械的特性としては、ある程度の剛（強度）を有するものが好ましいが、可撓性、弾性を有するものであってもよい。

【０１５８】このような一次、二次転写体１８０，２００の構成材料としては、各種合成樹脂または各種ガラス材が挙げられ、特に、各種合成樹脂や通常の（低融点の）安価なガラス材が好ましい。

【０１５９】合成樹脂としては、熱可塑性樹脂、熱硬化性樹脂のいずれでもよく、例えば、ポリエチレン、ポロプロピレン、エチレン－プレピレン共重合体、エチレン－酢酸ビニル共重合体（ＥＶＡ）等のポリオレフィン、環状ポリオレフィン、変性ポリオレフィン、ポリ塩化ビニル、ポリ塩化ビニリデン、ポリスチレン、ポリアミド、ポリイミド、ポリアミドイミド、ポリカーボネート、ポリ－（４－メチルベンテン－１）、アイオノマー、アクリル系樹脂、ポリメチルメタクリレート、アクリル－スチレン共重合体（ＡＳ樹脂）、ブタジエン－スチレン共重合体、ポリオ共重合体（ＥＶＯＨ）、ポリエチレンテレフタレート（ＰＥＴ）、ポリプチレンテレフタレート（ＰＢＴ）、プリシクロヘキサンテレフタレート（ＰＣＴ）等のポリエステル、ポリエーテル、ポリエーテルケトン（ＰＥＫ）、ポリエーテルエーテルケトン（ＰＥＥＫ）、ポリエーテルイミド、ポリアセタール（ＰＯＭ）、ポリフェニレンオキシド、変性ポリフェニ

レンオキシド、ポリアリレート、芳香族ポリエステル（液晶ポリマー）、ポリテトラフルオロエチレン、ポリフッ化ビニリデン、その他フッ素系樹脂、スチレン系、ポリオレフィン系、ポリ塩化ビニル系、ポリウレタン系、フッ素ゴム系、塩素化ポリエチレン系等の各種熱可塑性エラストマー、エポキシ樹脂、フェノール樹脂、ユリア樹脂、メラミン樹脂、不飽和ポリエステル、シリコーン樹脂、ポリウレタン等、またはこれらを主とする共重合体、ブレンド体、ポリマーアロイ等が挙げられ、これらのうちの１種または２種以上を組み合わせて（例えば２層以上の積層体として）用いることができる。

【０１６０】ガラス材としては、例えば、ケイ酸ガラス（石英ガラス）、ケイ酸アルカリガラス、ソーダ石灰ガラス、カリ石灰ガラス、鉛（アルカリ）ガラス、バリウムガラス、ホウケイ酸ガラス等が挙げられる。このうち、ケイ酸ガラス以外のものは、ケイ酸ガラスに比べて融点が低く、また、成形、加工も比較的容易であり、しかも安価であり、好ましい。

【０１６１】二次転写体２００として合成樹脂で構成されたものを用いる場合には、大型の二次転写体２００を一体的に成形することができるとともに、湾曲面や凹凸を有するもの等の複雑な形状であっても容易に製造することができ、また、材料コスト、製造コストも安価であるという種々の利点が享受できる。したがって、合成樹脂の使用は、大型で安価なデバイス（例えば、液晶ディスプレイ）を製造する上で有利である。

【０１６２】なお、二次転写体２００は、例えば、液晶セルのように、それ自体独立したデバイスを構成するものや、例えばカラーフィルター、電極層、誘電体層、絶縁層、半導体素子のように、デバイスの一部を構成するものであってもよい。

【０１６３】さらに、一次、二次転写体１８０，２００は、金属、セラミックス、石材、木材紙等の物質であってもよいし、ある品物を構成する任意の面上（時計の面上、エアコンの表面上、プリント基板の上等）、さらには壁、柱、天井、窓ガラス等の構造物の表面上であってもよい。

【０１６４】[追加工程２]次に、図３４に示すように、第２分離層である熱溶融性接着層１６０を加熱し、熱溶融させる。この結果、熱溶融性接着層１６０の接着力が弱まるため、一次転写体１８０を、薄膜デバイス層１４０により離脱させることができる。なお、一次転写体１８０に付着した熱溶融性接着剤を除去することで、この一次転写体１８０を繰り返し再利用することができる。

【０１６５】第２分離層１６０として上述した水溶性接着剤を用いた場合には、少なくとも第２分離層１６０を含む領域を水と接触させればよく、好ましくは純水に浸せばよい。第２分離層１６０として上述した有機溶剤溶融性接着剤を用いた場合には、少なくとも第２分離層１６０を含む領域を有機溶剤と接触させればよい。第２分離層１６０として上述した加熱または紫外線照射により剥離作用を呈する接着剤を用いた場合には、少なくとも第２分離層１６０を含む領域を、他の層を介して加熱または紫外線照射すればよい。また、第２分離層として第１分離層１２０と同様にアブレーション層を用いた場合には、光照射によって第２分離層１６０に剥離現象を生じさせる。このとき、注入イオンの効果によりその剥離が促進される。

【０１６６】[追加工程３]最後に、薄膜デバイス層１４０の表面に付着した第２分離層１６０を除去することで、図３５に示すように、二次転写体２００に転写された薄膜デバイス層１４０を得ることができる。ここで、この二次転写体２００に対する薄膜デバイス層１４０の積層関係は、図２に示すように当初の基板１００に対する薄膜デバイス層１４０の積層関係と同じとなる。

【０１６７】以上のような各工程を経て、被転写層（薄膜デバイス層）１４０の二次転写体２００への転写が完了する。その後、被転写層（薄膜デバイス層）１４０に隣接するＳｉO_2膜の除去や、被転写層１４０上への配線等の導電層や所望の保護膜の形成等を行うこともできる。

【０１６８】第２の実施の形態では、被剥離物である被転写層（薄膜デバイス層）１４０自体を直接に剥離するのではなく、第１分離層１２０及び第２分離層１６０において分離して二次転写体２００に転写するため、被分離物（被転写層１４０）の特性、条件等にかかわらず、容易かつ確実に、しかも均一に転写することができ、分離操作に伴う被分離物（被転写層１４０）へのダメージもなく、被転写層１４０の高い信頼性を維持することができる。

【０１６９】<第３の実施の形態>上述の第１，第２の実施の形態で説明した技術を用いると、例えば、図１９（ａ）に示すような、薄膜デバイスを用いて構成されたマイクロコンピュータを所望の基板上に形成できるようになる。

【０１７０】図１９（ａ）では、プラスチック等からなるフレキシブル基板１８２上に、薄膜デバイスを用いて回路が構成されたＣＰＵ３００，ＲＡＭ３２０，入出力回路３６０ならびに、これらの回路の電源電圧を供給するための、アモルファスシリコンのＰＩＮ接合を具備する太陽電池３４０が搭載されている。

【０１７１】図１９（ａ）のマイクロコンピュータはフレキシブル基板上に形成されているため、図１９（ｂ）に示すように曲げに強く、また、軽量であるために落下にも強いという特徴がある。

【０１７２】<第４の実施の形態>本実施の形態では、上述の薄膜デバイスの転写技術を用いて、図２０，図２１に示されるような、アクティブマトリクス基板を用いたアクティブマトリクス型の液晶表示装置を作成する場合の製造プロセスの例について説明する。

【０１７３】（液晶表示装置の構成）図２０に示すように、アクティブマトリクス型の液晶表示装置は、バックライト等の照明光源４００，偏光板４２０，アクティブマトリクス基板４４０，液晶４６０，対向基板４８０，偏光板５００を具備する。

【０１７４】なお、本発明のアクティブマトリクス基板４４０と対向基板４８０にプラスチックフィルムのようなフレキシブル基板を用いる場合は、照明光源４００に代えて反射板を採用した反射型液晶パネルとして構成すると、可撓性があって衝撃に強くかつ軽量なアクティブマトリクス型液晶パネルを実現できる。なお、画素電極を金属で形成した場合、反射板および偏光板４２０は不要となる。

【０１７５】本実施の形態で使用するアクティブマトリクス基板４４０は、画素部４４２にＴＦＴを配置し、さらに、ドライバ回路（走査線ドライバおよびデータ線ドライバ）４４４を搭載したドライバ内蔵型のアクティブマトリクス基板である。

【０１７６】このアクティブマトリクス型液晶表示装置の要部の断面図が図２１に示され、また、液晶表示装置の要部の回路構成が図２２に示される。

【０１７７】図２２に示されるように、画素部４４２は、ゲートがゲート線Ｇ１に接続され、ソース・ドレインの一方がデータ線Ｄ１に接続され、ソース・ドレインの他方が液晶４６０に接続されたＴＦＴ（Ｍ１）と、液晶４６０とを含む。

【０１７８】また、ドライバー部４４４は、画素部のＴＦＴ（Ｍ１）と同じプロセスにより形成されるＴＦＴ（Ｍ２）を含んで構成される。

【０１７９】図２１の左側に示されるように、画素部４４２におけるＴＦＴ（Ｍ１）は、ソース・ドレイン層１１００ａ，１１００ｂと、チャンネル１１００ｅと、ゲート絶縁膜１２００ａと、ゲート電極１３００ａと、絶縁膜１５００と、ソース・ドレイン電極１４００ａ，１４００ｂとを含んで構成される。

【０１８０】なお、参照番号１７００は画素電極であり、参照番号１７０２は画素電極１７００が液晶４６０に電圧を印加する領域（液晶への電圧印加領域）を示す。図中、配向膜は省略してある。画素電極１７００はＩＴＯ（光透過型の液晶パネルの場合）あるいはアルミニュウム等の金属（反射型の液晶パネルの場合）により構成される。また、図２１では、液晶への電圧印加領域１７０２において、画素電極１７００の下の下地絶縁膜（中間層）１０００は完全に除去されているが、必ずしもこれに限定されるものではなく、下地絶縁膜（中間層）１０００が薄いために液晶への電圧印加の妨げにならない場合には残しておいてもよい。

【０１８１】また、図２１の右側に示されるように、ドライバー部４４４を構成するＴＦＴ（Ｍ２）は、ソース，ドレイン層１１００ｃ，１１００ｄと、チャンネル１１００ｆと、ゲート絶縁膜１２００ｂと、ゲート電極１３００ｂと、絶縁膜１５００と、ソース・ドレイン電極１４００ｃ，１４００ｄとを含んで構成される。

【０１８２】なお、図２１において、参照番号４８０は、例えば、対向基板（例えば、ソーダガラス基板）であり、参照番号４８２は共通電極である。また、参照番号１０００はSiO_2膜であり、参照番号１６００は層間絶縁膜（例えば、SiO_2膜）であり、参照番号１８００は接着層である。また、参照番号１９００は、例えばソーダガラス基板からなる基板（転写体）である。

【０１８３】（液晶表示装置の製造プロセス）以下、図２１の液晶表示装置の製造プロセスについて、図２３～図２７を参照して説明する。

【０１８４】まず、図８～図１８と同様の製造プロセスを経て、図２３のようなＴＦＴ（Ｍ１，Ｍ２）を、信頼性が高くかつレーザー光を透過する基板（例えば、石英基板）３０００上に形成し、保護膜１６００を構成する。なお、図２３において、参照番号３１００は、剥離促進用イオンが注入されている分離層（レーザー吸収層）である。また、図２３では、ＴＦＴ（Ｍ１，Ｍ２）は共にｎ型のＭＯＳＦＥＴとしている。但し、これに限定されるものではなく、ｐ型のＭＯＳＦＥＴや、ＣＭＯＳ構造としてもよい。

【０１８５】次に、図２４に示すように、保護膜１６００および下地絶縁膜１０００を選択的にエッチングし、選択的に開口部４０００，４２００を形成する。これらの２つの開口部は共通のエッチング工程を用いて同時に形成する。なお、図２４では開口部４２００において、下地絶縁膜（中間層）１０００を完全に除去しているが、必ずしもこれに限定されるものではなく、下地絶縁膜（中間層）１０００が薄いために液晶への電圧印加の妨げにならない場合には残しておいてもよい。

【０１８６】次に、図２５に示すように、ＩＴＯ膜あるいはアルミニュウム等の金属からなる画素電極１７００を形成する。ＩＴＯ膜を用いる場合には透過型の液晶パネルとなり、アルミニュウム等の金属を用いる場合には反射型の液晶パネルとなる。次に、図２６に示すように、接着層１８００を介して基板１９００を接合（接着）する。

【０１８７】次に、図２６に示すように、基板３０００の裏面からエキシマレーザー光を照射し、剥離促進用イオンによる作用も利用して分離層１２０に剥離現象を生じさせる。この後、基板３０００を引き剥がす。このとき、引き剥がしにさほどの力を要しないので、ＴＦＴなどには機械的ダメージが生じない。

【０１８８】次に、分離層（レーザー吸収層）３１００を除去する。これにより、図２７に示すようなアクティブマトリクス基板４４０が完成する。画素電極１７００の底面（参照番号１７０２の領域）は露出しており、液晶との電気的な接続が可能となっている。この後、アク

ティブマトリクス基板４４０の絶縁膜（ＳｉO_2などの中間層）１０００の表面および画素電極１７０２表面に配向膜を形成して配向処理が施される。図２７では、配向膜は省略してある。

【０１８９】そして、さらにその表面に画素電極１７０９と対向する共通電極が形成され、その表面が配向処理された対向基板４８０と図２１のアクティブマトリク基板４４０とを封止材（シール材）で封止し、両基板の間に液晶を封入して、図２１に示すような液晶表示装置が完成する。

【０１９０】＜第５の実施の形態＞図２８に本発明の第５の実施の形態を示す。

【０１９１】本実施の形態では、上述の薄膜デバイスの転写方法を複数回実行して、転写元の基板よりも大きい基板（転写体）上に薄膜デバイスを含む複数のパターンを転写し、最終的に大規模なアクティブマトリクス基板を形成する。

【０１９２】つまり、大きな基板７０００上に、複数回の転写を実行し、画素部７１００ａ～７１００Ｐを形成する。図２８の上側に一点鎖線で囲んで示されるように、画素部には、ＴＦＴや配線が形成されている。図２８において、参照番号７２１０は走査線であり、参照番号７２００は信号線であり、参照番号７２２０はゲート電極であり、参照番号７２３０は画素電極である。

【０１９３】信頼性の高い基板を繰り返し使用し、あるいは複数の第１の基板を使用して薄膜パターンの転写を複数回実行することにより、信頼性の高い薄膜デバイスを搭載した大規模なアクティブマトリクス基板を作成できる。

【０１９４】＜第６の実施の形態＞本発明の第６の実施の形態を図２９に示す。

【０１９５】本実施の形態の特徴は、上述の薄膜デバイスの転写方法を複数回実行して、転写元の基板上よりも大きな基板上に、設計ルール（つまりパターン設計する上でのデザインルール）が異なる薄膜デバイス（つまり、最小線幅が異なる薄膜デバイス）を含む複数のパターンを転写することである。

【０１９６】図２９では、ドライバー搭載のアクティブマトリクス基板において、画素部（７１００ａ～７１００ｐ）よりも、より微細な製造プロセスで作成されたドライバ回路（８０００～８０３２）を、複数回の転写によって基板６０００の周囲に作成してある。

【０１９７】ドライバ回路を構成するシフトレジスタは、低電圧下においてロジックレベルの動作をするので画素ＴＦＴよりも耐圧が低くてよく、よって、画素ＴＦＴより微細なＴＦＴとなるようにして高集積化を図ることができる。

【０１９８】本実施の形態によれば、設計ルールレベルの異なる（つまり製造プロセスが異なる）複数の回路を、一つの基板上に実現できる。なお、シフトレジスタの制御によりデータ信号をサンプリングするサンプリング手段（図２２の薄膜トランジスタＭ２）は、画素ＴＦＴ同様に高耐圧が必要なので、画素ＴＦＴと同一プロセス／同一設計ルールで形成してもよい。

【０１９９】

【実施例】次に、本発明の具体的実施例について説明する。

【０２００】（実施例１）縦５０㎜×横５０㎜×厚さ１．１㎜の石英基板（軟化点：１６３０℃、歪点：１０７０℃、エキシマレーザの透過率：ほぼ１００％）を用意し、この石英基板の片面に、分離層（レーザ光吸収層）として非晶質シリコン（ａ－Ｓｉ）膜を低圧ＣＶＤ法（Si_2H_6 ガス、４２５℃）により形成した。分離層の膜厚は、１００nmであった。

【０２０１】次に、分離層上に、中間層としてＳｉO_2膜をＥＣＲ－ＣＶＤ法（ＳｉH_4＋O_2 ガス、１００℃）により形成した。中間層の膜厚は、２００nmであった。

【０２０２】次に、中間層上に、被転写層として膜厚５０nmの非晶質シリコン膜を低圧ＣＶＤ法（Si_2H_6 ガス、４２５℃）により形成し、この非晶質シリコン膜にレーザ光（波長３０８nm）を照射して、結晶化させ、ポリシリコン膜とした。その後、このポリシリコン膜に対し、所定のパターンニングを施し、薄膜トランジスタのソース・ドレイン・チャネルとなる領域を形成した。この後、ＴＥＯＳ－ＣＶＤ法（ＳｉH_4＋O_2ガス）により１２００ｎｍのゲート絶縁膜ＳｉO_2 を形成した後、ゲート絶縁膜上にゲート電極（ポリシリコンにＭｏ等の高融点金属が積層形成された構造）を形成し、ゲート電極をマスクとしてイオン注入することによって、自己整合的（セルファライン）にソース・ドレイン領域を形成し、薄膜トランジスタを形成した。このとき同時に、水素イオンを分離層に注入した。この後、必要に応じて、ソース・ドレイン領域に接続される電極及び配線、ゲート電極につながる配線が形成される。これらの電極や配線にはＡｌが使用されるが、これに限定されるものではない。また、後工程のレーザー照射によりＡｌの溶融が心配される場合は、Ａｌよりも高融点の金属（後工程のレーザー照射により溶融しないもの）を使用してもよい。

【０２０３】次に、前記薄膜トランジスタの上に、紫外線硬化型接着剤を塗布し（膜厚：１００μｍ）、さらにその塗膜に、転写体として縦２００㎜×横３００㎜×厚さ１．１㎜の大型の透明なガラス基板（ソーダガラス、軟化点：７４０℃、歪点：５１１℃）を接合した後、ガラス基板側から紫外線を照射して接着剤を硬化させ、これらを接着固定した。

【０２０４】次に、Ｘｅ－Ｃｌエキシマレーザ（波長：３０８nm）を石英基板側から照射し、図３１以降に示すビームスキャンを実施することで、分離層に剥離（層内

剥離および界面剥離）を生じさせた。照射したＸｅ－Ｃｌエキシマレーザのエネルギー密度は、２５０mJ/cm²、照射時間は、２０nsecであった。なお、エキシマレーザの照射は、スポットビーム照射とラインビーム照射とがあり、スポットビーム照射の場合は、所定の単位領域（例えば8mm×8mm）にスポット照射し、このスポット照射を、各回の照射領域が重ならないように（前後左右にて重ならないように）ビーム走査しながら照射していった。また、ラインビーム照射の場合は、所定の単位領域（例えば３７８mm×０．１mmや３７８mm×０．３mm（これらはエネルギーの９０%以上が得られる領域））を同じく、各回の照射領域が重ならないようにビーム走査しながら照射していった。

【０２０５】この後、石英基板とガラス基板（転写体）とを分離層において引き剥がし、石英基板上に形成された薄膜トランジスタおよび中間層を、ガラス基板側に転写した。

【０２０６】その後、ガラス基板側の中間層の表面に付着した分離層を、エッチングや洗浄またはそれらの組み合わせにより除去した。また、石英基板についても同様の処理を行い、再使用に供した。

【０２０７】なお、転写体となるガラス基板が石英基板より大きな基板であれば、本実施例のような石英基板からガラス基板への転写を、平面的に異なる領域に繰り返して実施し、ガラス基板上に、石英基板に形成可能な薄膜トランジスタの数より多くの薄膜トランジスタを形成することができる。さらに、ガラス基板上に繰り返し積層し、同様により多くの薄膜トランジスタを形成することができる。

【０２０８】（実施例２）分離層を、分離層形成プロセスにてＨ（水素）を２０at%含有する非晶質シリコン膜とした以外は実施例１と同様にして、薄膜トランジスタの転写を行った。

【０２０９】なお、非晶質シリコン膜中のＨ量の調整は、低圧ＣＶＤ法による成膜時の条件を適宜設定することにより行った。

【０２１０】（実施例３）分離層を、スピンコートによりゾルーゲル法で形成したセラミックス薄膜（組成：ＰｂＴｉO_3、膜厚：２００nm）とした以外は実施例１と同様にして、薄膜トランジスタの転写を行った。

【０２１１】（実施例４）分離層を、スパッタリングにより形成したセラミックス薄膜（組成：ＢａＴｉO_3、膜厚：４００nm）とした以外は実施例１と同様にして、薄膜トランジスタの転写を行った。

【０２１２】（実施例５）分離層を、レーザーアブレーション法により形成したセラミックス薄膜（組成：Ｐｂ（Ｚｒ，Ｔｉ）O_3（ＰＺＴ）、膜厚：５０nm）とした以外は実施例１と同様にして、薄膜トランジスタの転写を行った。

【０２１３】（実施例６）分離層を、スピンコートにより形成したポリイミド膜（膜厚：２００nm）とした以外は実施例１と同様にして、薄膜トランジスタの転写を行った。

【０２１４】（実施例７）分離層を、スピンコートにより形成したポリフェニレンサルファイド膜（膜厚：２００nm）とした以外は実施例１と同様にして、薄膜トランジスタの転写を行った。

【０２１５】（実施例８）分離層を、スパッタリングにより形成したＡｌ層（膜厚：３００nm）とした以外は実施例１と同様にして、薄膜トランジスタの転写を行った。

【０２１６】（実施例９）照射光として、Ｋｒ－Ｆエキシマレーザ（波長：２４８nm）を用いた以外は実施例２と同様にして、薄膜トランジスタの転写を行った。なお、照射したレーザのエネルギー密度は、２５０mJ/cm²、照射時間は、２０nsecであった。

【０２１７】（実施例１０）照射光として、Ｎｄ－ＹＡＩＧレーザ（波長：１０６８nm）を用いた以外は実施例２と同様にして薄膜トランジスタの転写を行った。なお、照射したレーザのエネルギー密度は、４００mJ/cm²、照射時間は、２０nsecであった。

【０２１８】（実施例１１）被転写層として、高温プロセス１０００℃によるポリシリコン膜（膜厚８０nm）の薄膜トランジスタとした以外は実施例１と同様にして、薄膜トランジスタの転写を行った。

【０２１９】（実施例１２）転写体として、ポリカーボネート（ガラス転移点：１３０℃）製の透明基板を用いた以外は実施例１と同様にして、薄膜トランジスタの転写を行った。

【０２２０】（実施例１３）転写体として、ＡＳ樹脂（ガラス転移点：７０～９０℃）製の透明基板を用いた以外は実施例２と同様にして、薄膜トランジスタの転写を行った。

【０２２１】（実施例１４）転写体として、ポリメチルメタクリレート（ガラス転移点：７０～９０℃）製の透明基板を用いた以外は実施例３と同様にして、薄膜トランジスタの転写を行った。

【０２２２】（実施例１５）転写体として、ポリエチレンテレフタレート（ガラス転移点：６７℃）製の透明基板を用いた以外は、実施例５と同様にして、薄膜トランジスタの転写を行った。

【０２２３】（実施例１６）転写体として、高密度ポリエチレン（ガラス転移点：７７～９０℃）製の透明基板を用いた以外は実施例６と同様にして、薄膜トランジスタの転写を行った。

（実施例１７）転写体として、ポリアミド（ガラス転移点：１４５℃）製の透明基板を用いた以外は実施例９と同様にして、薄膜トランジスタの転写を行った。

【０２２４】（実施例１８）転写体として、エポキシ樹脂（ガラス転移点：１２０℃）製の透明基板を用いた以

外は実施例１０と同様にして、薄膜トランジスタの転写を行った。

【０２２５】（実施例１９）転写体として、ポリメチルメタクリレート（ガラス転移点：７０～９０℃）製の透明基板を用いた以外は実施例１１と同様にして、薄膜トランジスタの転写を行った。

【０２２６】実施例１～１９について、それぞれ、転写された薄膜トランジスタの状態を肉眼と顕微鏡とで視観察したところ、いずれも、欠陥やムラがなく、均一に転写がなされていた。

【０２２７】以上述べたように、本発明の転写技術を用いれば、薄膜デバイス（被転写層）を種々の転写体へ転写することが可能となり、特に転写に必要な基板の剥離を過度の力を作用せずに無理なく行うことができた。これにより、例えば薄膜を直接形成することができないかまたは形成するのに適さない材料、成形が容易な材料、安価な材料等で構成されたものや、移動しにくい大型の物体等に対しても、転写によりそれを形成することができる。

【０２２８】特に、転写体は、各種合成樹脂や融点の低いガラス材のような、基板材料に比べ耐熱性、耐食性等の特性が劣るものを用いることができる。そのため、例えば、透明基板上に薄膜トランジスタ（特にポリシリコンＴＦＴ）を形成した液晶ディスプレイを製造するに際しては、基板として、耐熱性に優れる石英ガラス基板を用い、転写体として、各種合成樹脂や融点の低いガラス材のような安価でかつ加工のし易い材料の透明基板を用いることにより、大型で安価な液晶ディスプレイを容易に製造することができるようになる。このような利点は、液晶ディスプレイに限らず、他のデバイスの製造についても同様である。

【０２２９】また、以上のような利点を享受しつつも、信頼性の高い基板、特に石英ガラス基板のような耐熱性の高い基板に対し機能性薄膜のような被転写層を形成し、さらにはパターニングすることができるので、転写体の材料特性にかかわらず、転写体上に信頼性の高い機能性薄膜を形成することができる。

【０２３０】また、このような信頼性の高い基板は、高価であるが、それを再利用することも可能であり、よって、製造コストも低減される。

【０２３１】

【図面の簡単な説明】

【図１】本発明の薄膜デバイスの転写方法の第１の実施の形態における第１の工程を示す断面図である。

【図２】本発明の薄膜デバイスの転写方法の第１の実施の形態における第２の工程を示す断面図である。

【図３】本発明の薄膜デバイスの転写方法の第１の実施の形態における第３の工程を示す断面図である。

【図４】本発明の薄膜デバイスの転写方法の第１の実施の形態における第４の工程を示す断面図である。

【図５】本発明の薄膜デバイスの転写方法の第１の実施の形態における第５の工程を示す断面図である。

【図６】本発明の薄膜デバイスの転写方法の第１の実施の形態における第６の工程を示す断面図である。

【図７】第１の基板（図１の基板１００）のレーザー光の波長に対する透過率の変化を示す図である。

【図８】図２の薄膜デバイスを形成するための第１の工程を示す断面図である。

【図９】図２の薄膜デバイスを形成するための第２の工程を示す断面図である。

【図１０】図２の薄膜デバイスを形成するための第３の工程を示す断面図である。

【図１１】図２の薄膜デバイスを形成するための第４の工程を示す断面図である。

【図１２】図２の薄膜デバイスを形成するための第５の工程を示す断面図である。

【図１３】図２の薄膜デバイスを形成するための第６の工程を示す断面図である。

【図１４】図２の薄膜デバイスを形成するための第７の工程を示す断面図である。

【図１５】図３に示す工程を詳細に示すための断面図である。

【図１６】図４に示す工程の詳細を示すための断面図である。

【図１７】図５に示す工程の詳細を示すための断面図である。

【図１８】図６に示す工程の詳細を示すための断面図である。

【図１９】（ａ），（ｂ）は共に、本発明を用いて製造されたマイクロコンピュータの斜視図である。

【図２０】液晶表示装置の構成を説明するための図である。

【図２１】液晶表示装置の要部の断面構造を示す図である。

【図２２】液晶表示装置の要部の構成を説明するための図である。

【図２３】本発明を用いたアクティブマトリクス基板の製造方法の第１の工程を示すデバイスの断面図である。

【図２４】本発明を用いたアクティブマトリクス基板の製造方法の第２の工程を示すデバイスの断面図である。

【図２５】本発明を用いたアクティブマトリクス基板の製造方法の第３の工程を示すデバイスの断面図である。

【図２６】本発明を用いたアクティブマトリクス基板の製造方法の第４の工程を示すデバイスの断面図である。

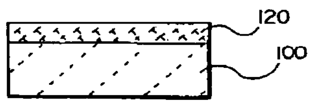
【図２７】本発明を用いたアクティブマトリクス基板の製造方法の第５の工程を示すデバイスの断面図である。

【図２８】本発明の薄膜デバイスの転写方法の他の例を説明するための図である。

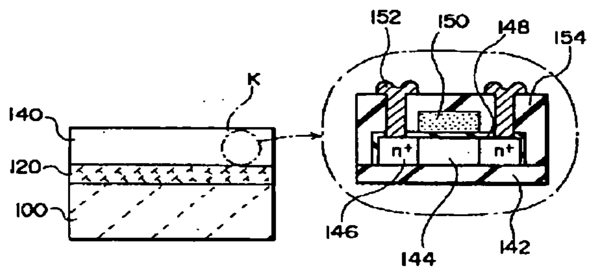
【図２９】本発明の薄膜デバイスの転写方法のさらに他の例を説明するための図である。

【図３０】本発明の薄膜デバイスの転写方法の変形例を説明するための図である。
【図３１】図９の工程の後に実施される剥離促進用イオンの注入工程を示す断面図である。
【図３２】図１０の工程の後に実施される剥離促進用イオンの注入工程を示す断面図である。
【図３３】図６の工程に引き続いて行われる二度転写時の追加工程１を示す概略断面図である。
【図３４】図３３の工程に引き続いて行われる二度転写時の追加工程２を示す概略断面図である。
【図３５】図３４の工程に引き続いて行われる二度転写時の追加工程３を示す概略断面図である。
【符号の説明】
１００　基板
１２０　分離層
１４０　薄膜デバイス層
１６０　接着層
１８０　転写体

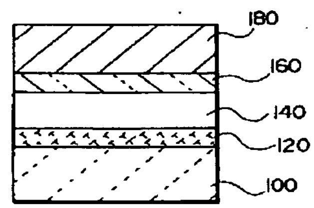
【図１】



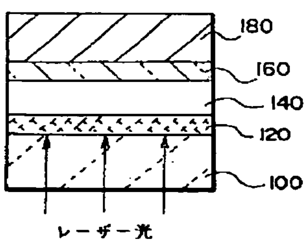
【図２】



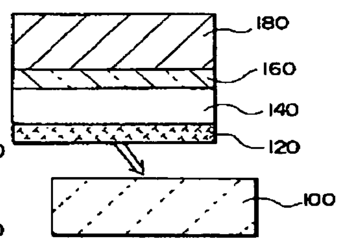
【図３】



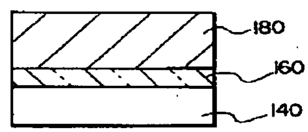
【図４】



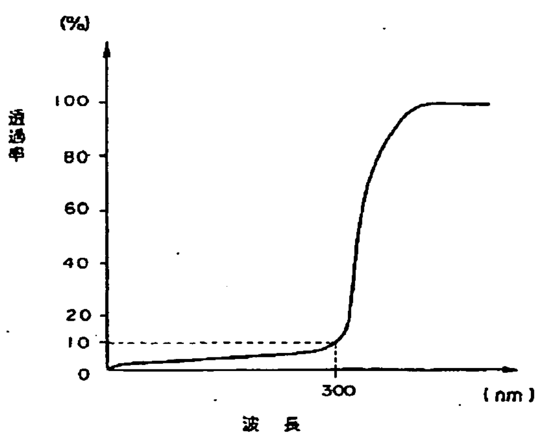
【図５】



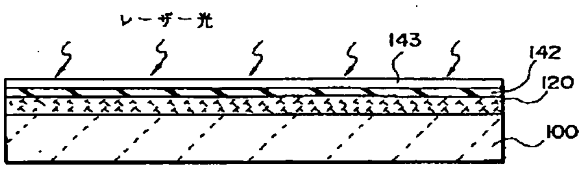
【図６】



【図７】



【図８】



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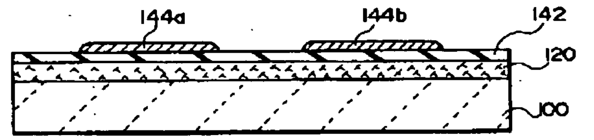

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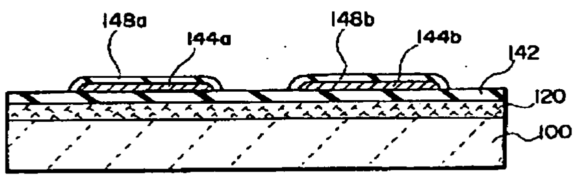

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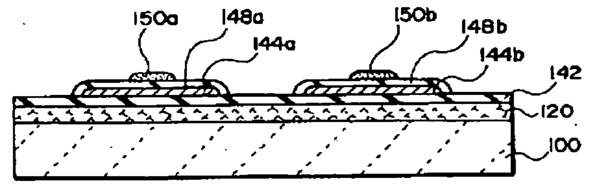

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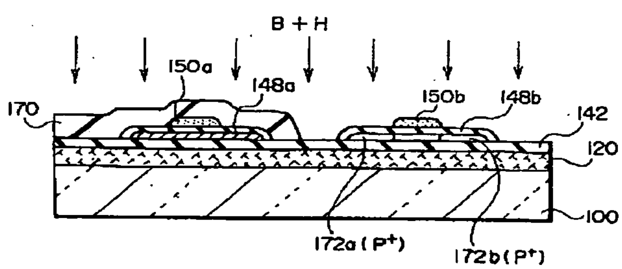

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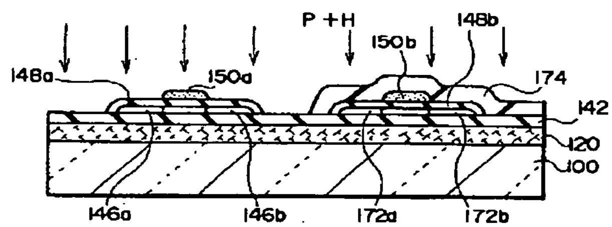

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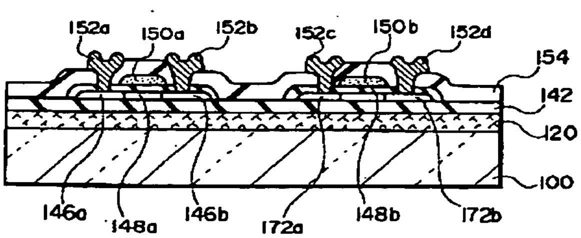

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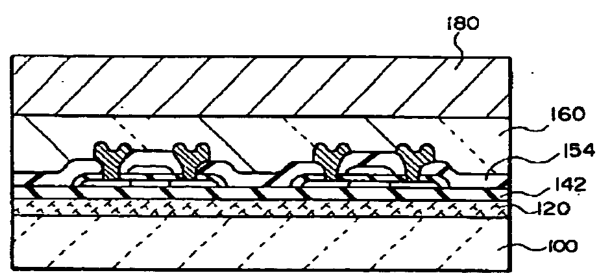

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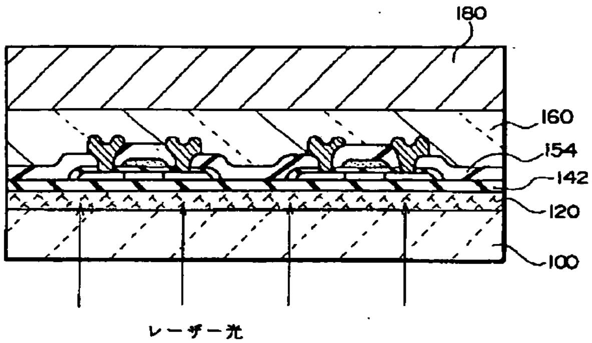

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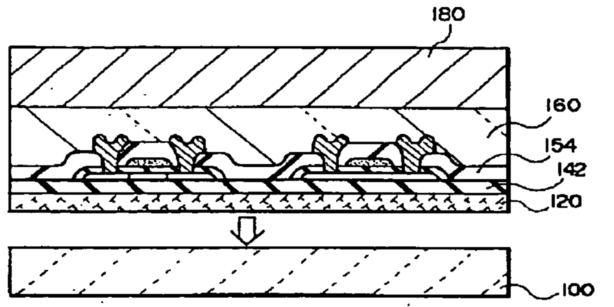

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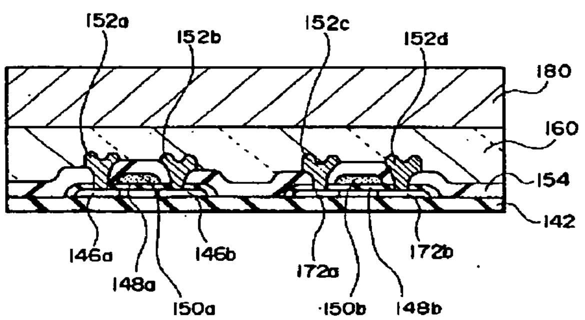

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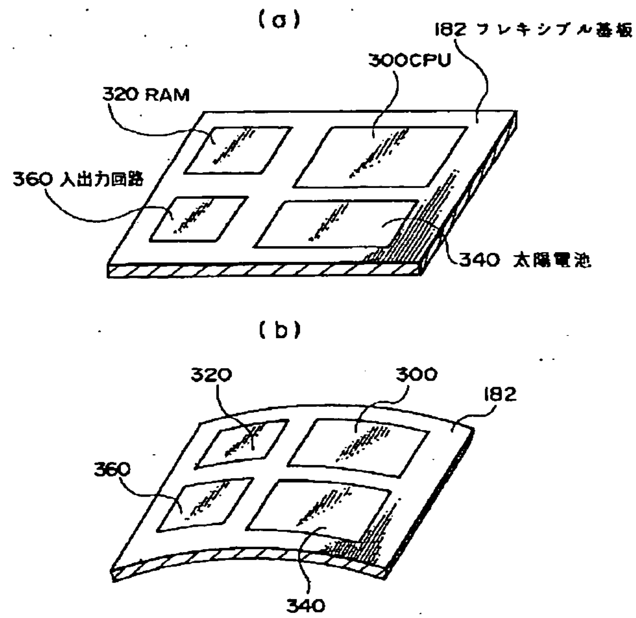

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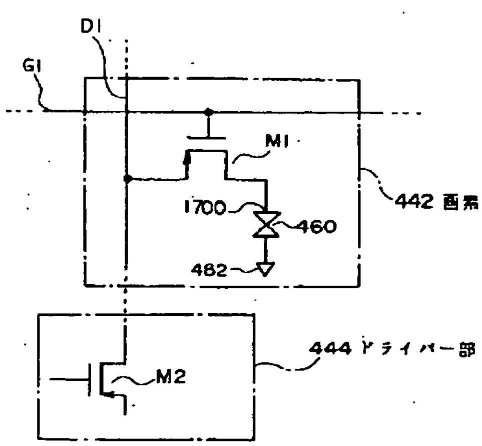

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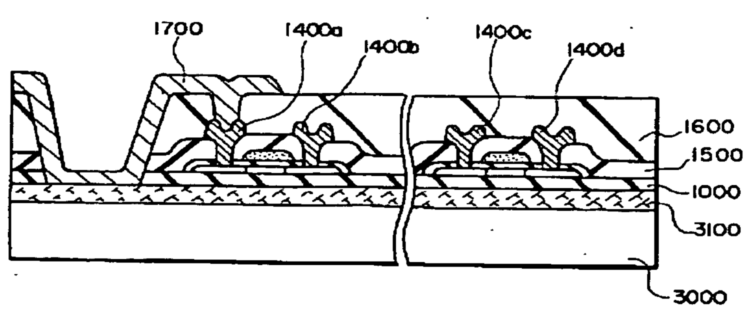

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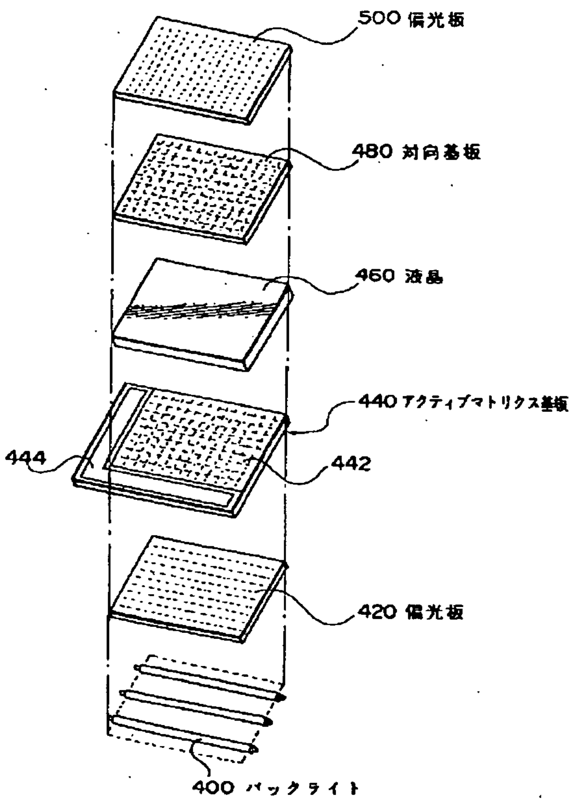

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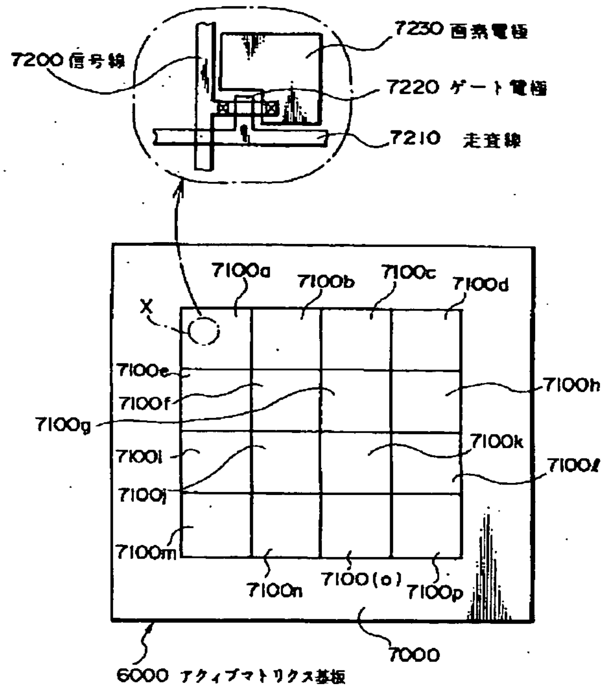

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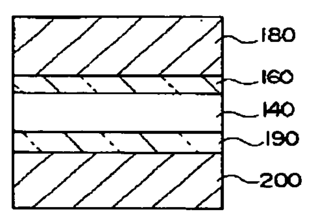

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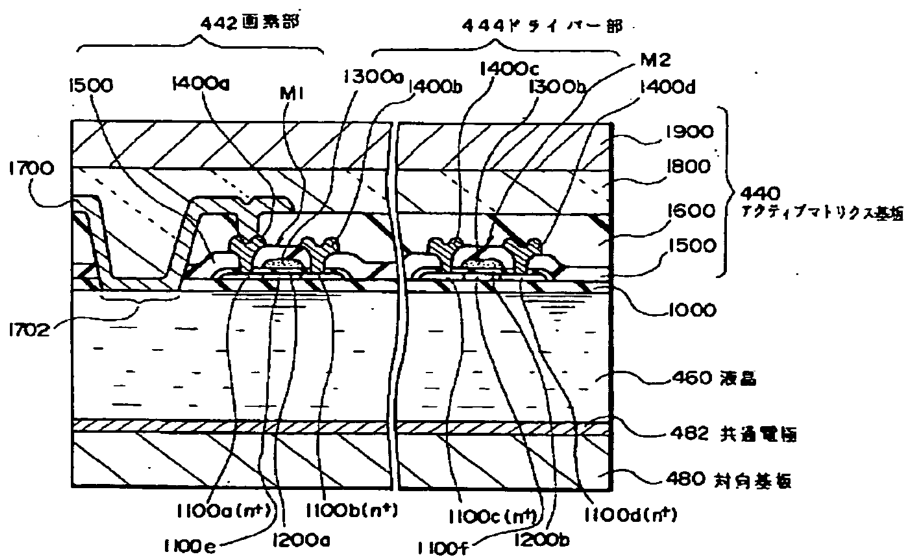

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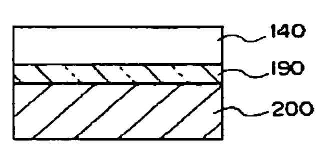

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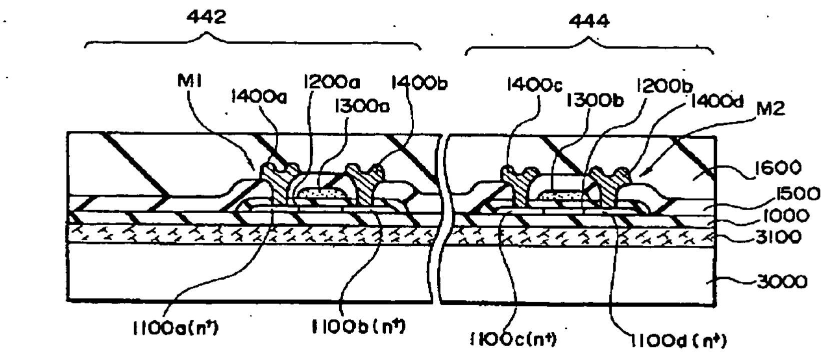

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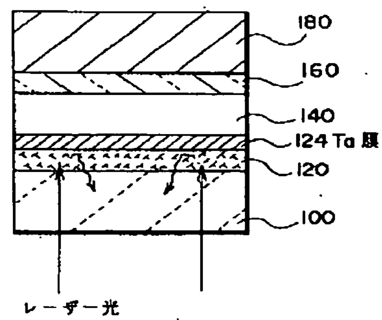

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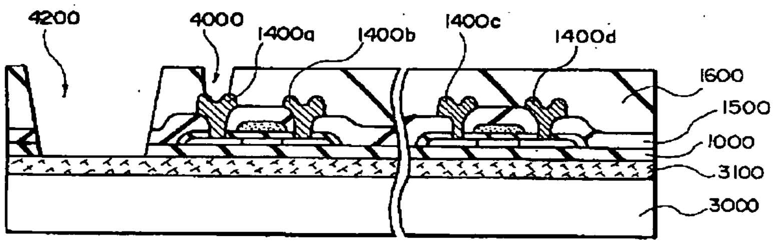

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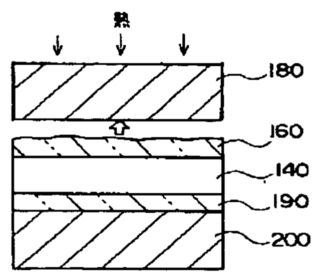

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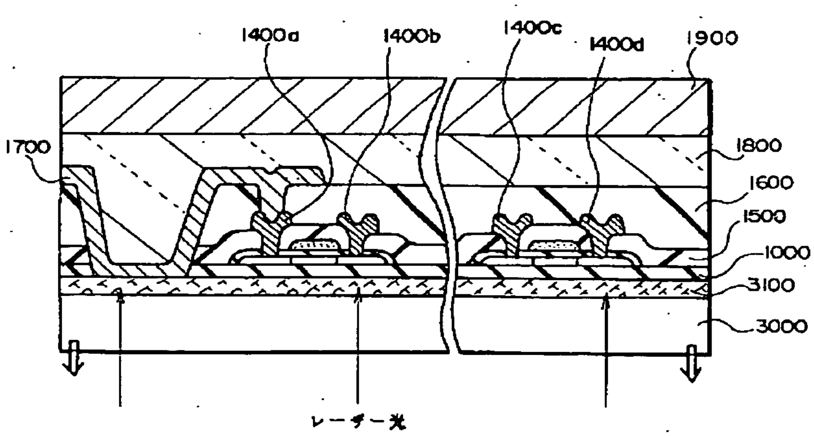

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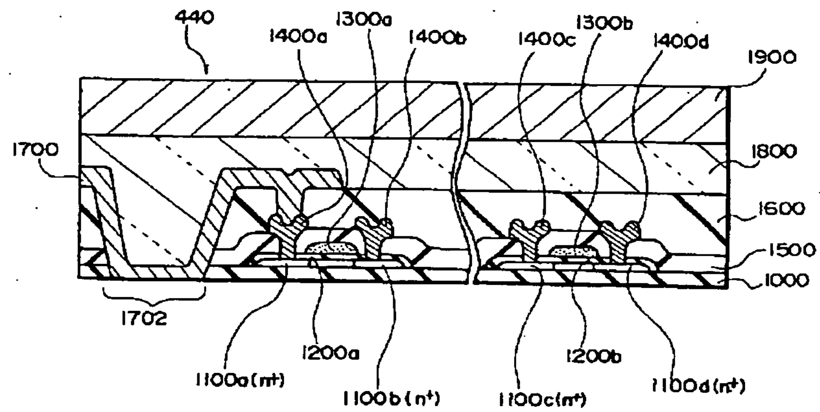

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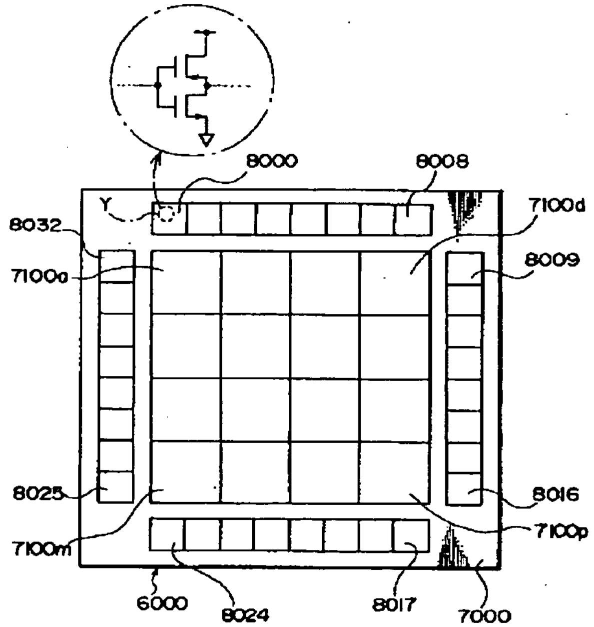

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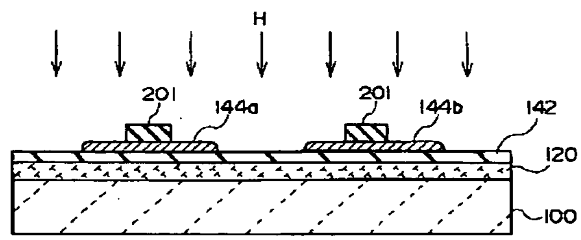

【図３２】